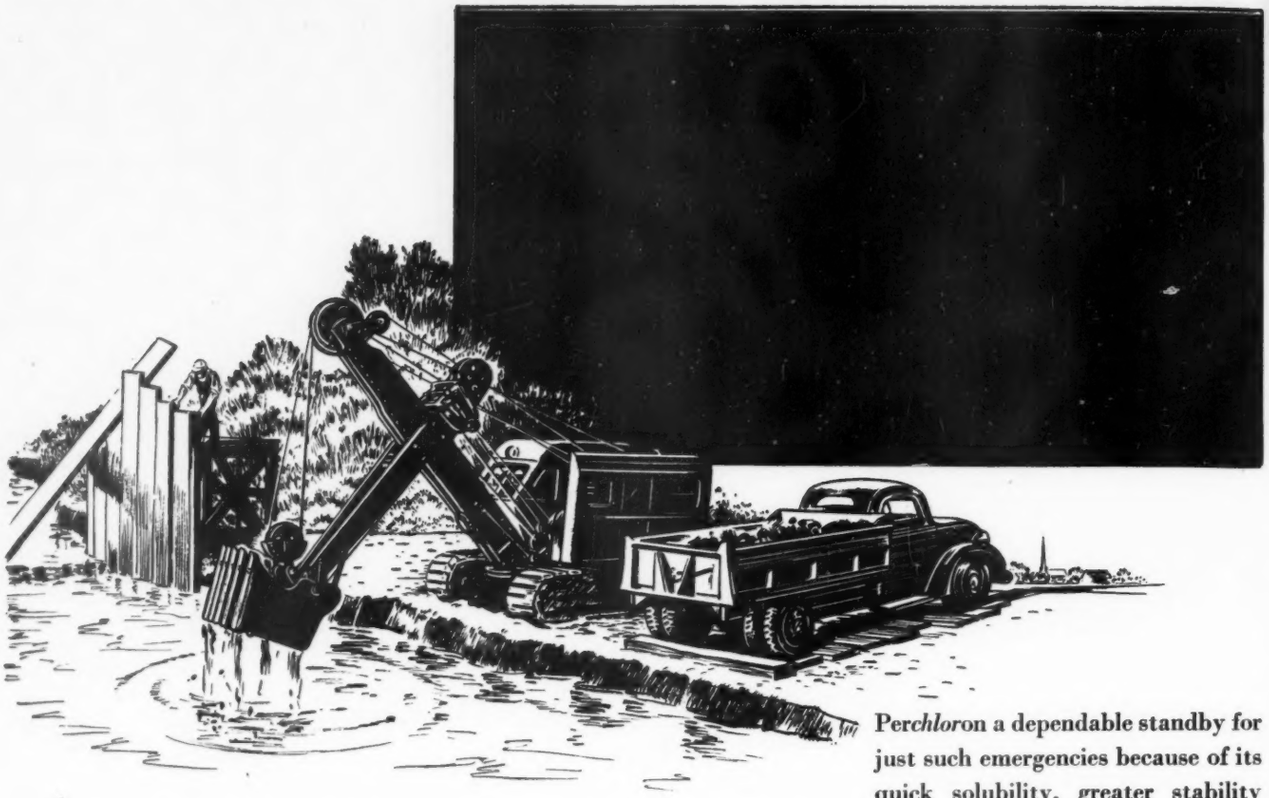
WATER WORKS & SEWERAGE

LOBBY OF THE NEW 6 M.G.D. FILTER PLANT
OF NEWPORT NEWS, VA.



A steam shovel, excavating for new bridge foundations, struck and broke an important main in the water supply of a New York village. The main was buried in the bed of a stream which carried sewage from many village homes. This sewage, washing in and around the break at this low point in the lines, meant a serious threat to public health.

But the waterworks engineer was well prepared to meet such an emergency. His first thought was Per*chloro*n—a quick, dependable means of sanitizing the water supply and safeguarding the health of his fellow townspeople.

Sleeves were applied to the broken main to reduce sewage infiltration and partially restore the water pressure. Taps were made on both sides of the break, and Per*chloro*n was pumped into the main through each tap. Within a few minutes, 3 ppm residual chlorine was detected in nearby domestic water services. This residual was maintained during the five days required to replace the broken pipe.

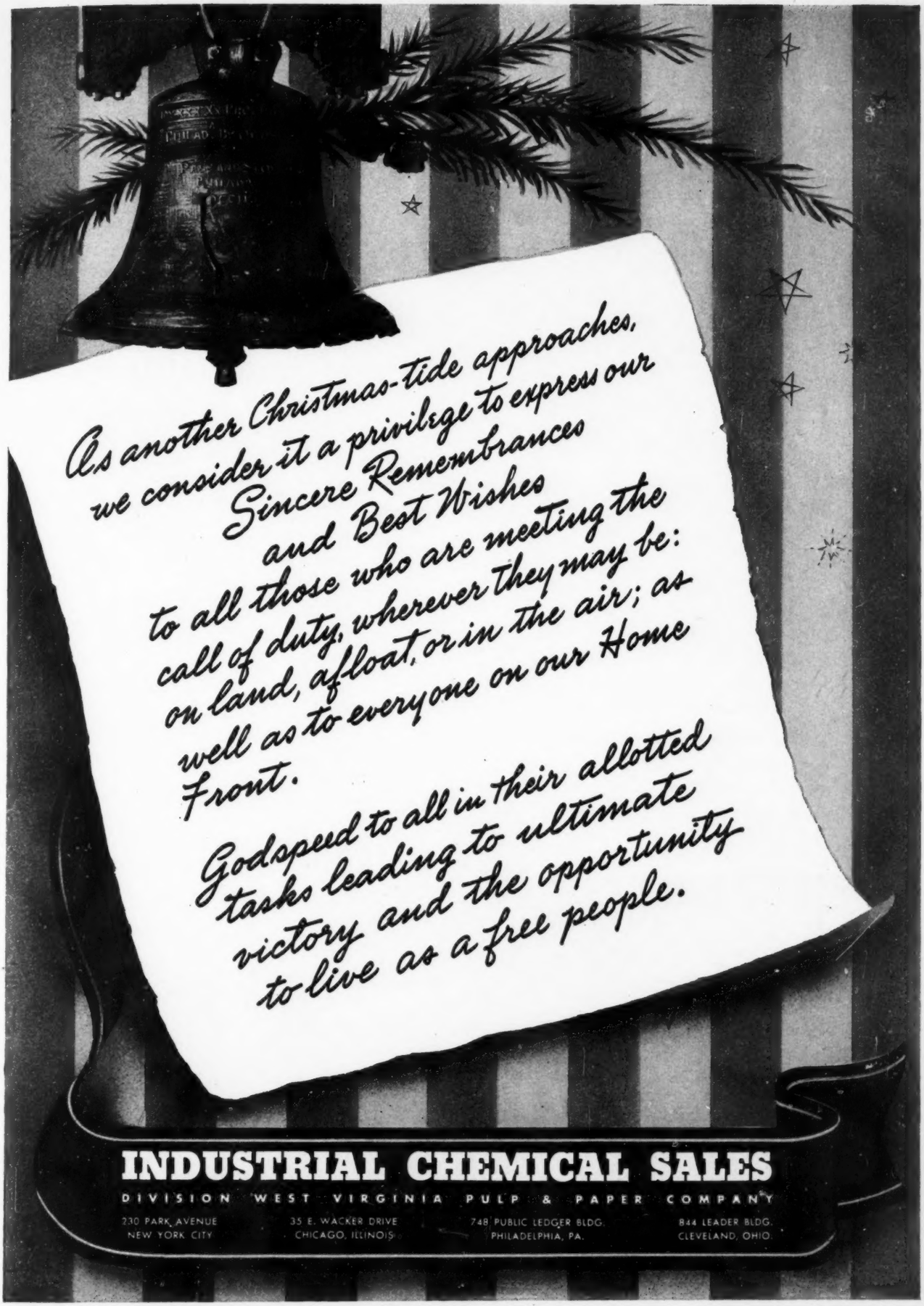
No B Coli were found in the system as a result of this break. The engineer says, "We give a good deal of credit to Per*chloro*n for our clean record during this emergency."

Waterworks engineers in every section of the country have found Per*chloro*n a dependable standby for just such emergencies because of its quick solubility, greater stability and high chlorine content—more than 70% available chlorine. They use it also for sanitizing small water systems, new mains, wells and swimming pools.

At present, Per*chloro*n is, of course, being used to meet urgent war time demands, and we ask our customers to cooperate with us by ordering only for immediate needs, *well in advance* . . . To help you solve some of today's unusual problems, there is a nearby Penn Salt representative who is at your service without obligation. And if you do not have your *free* copy of our illustrated booklet on Per*chloro*n, with valuable data on water purification and sewage treatment, write today to Dept. WS.

Perchloron

REG. U.S. PAT. OFF.


As another Christmas-tide approaches,
we consider it a privilege to express our
Sincere Remembrances
and Best Wishes
to all those who are meeting the
call of duty, wherever they may be:
on land, afloat, or in the air; as
well as to everyone on our Home
Front.
Godspeed to all in their allotted
tasks leading to ultimate
victory and the opportunity
to live as a free people.
INDUSTRIAL CHEMICAL SALES
DIVISION WEST VIRGINIA PULP & PAPER COMPANY
230 PARK AVENUE NEW YORK CITY
35 E. WACKER DRIVE CHICAGO, ILLINOIS
748 PUBLIC LEDGER BLDG. PHILADELPHIA, PA.
844 LEADER BLDG. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, December, 1942. Volume 89. Number 12. Published monthly by Gillette Publishing Co., 330 South Wells Street, Chicago, Ill. Per copy, 25c. Subscription rate, United States, $2.00 per year; Canada, $2.00 per year; Foreign, $3.00 per year. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

OUR CHRISTMAS WISHES FOR YOU...

May your holiday be drifted high with gifts and giving, with happiness and friends.

May your Christmas be a brisk and cheerful island in this year's savage seas.

May your New Year be a turning point towards constructive, peaceful days.

May your 1943 be useful, busy, prosperous. May you find it crowned with Victory.

May you never forget our thanks for years of cordial dealings.

May you continue to understand our war-caused delivery problems, and may you, like ourselves, close soon the biggest, busiest, hardest year of your entire history.

MATHEWS HYDRANTS

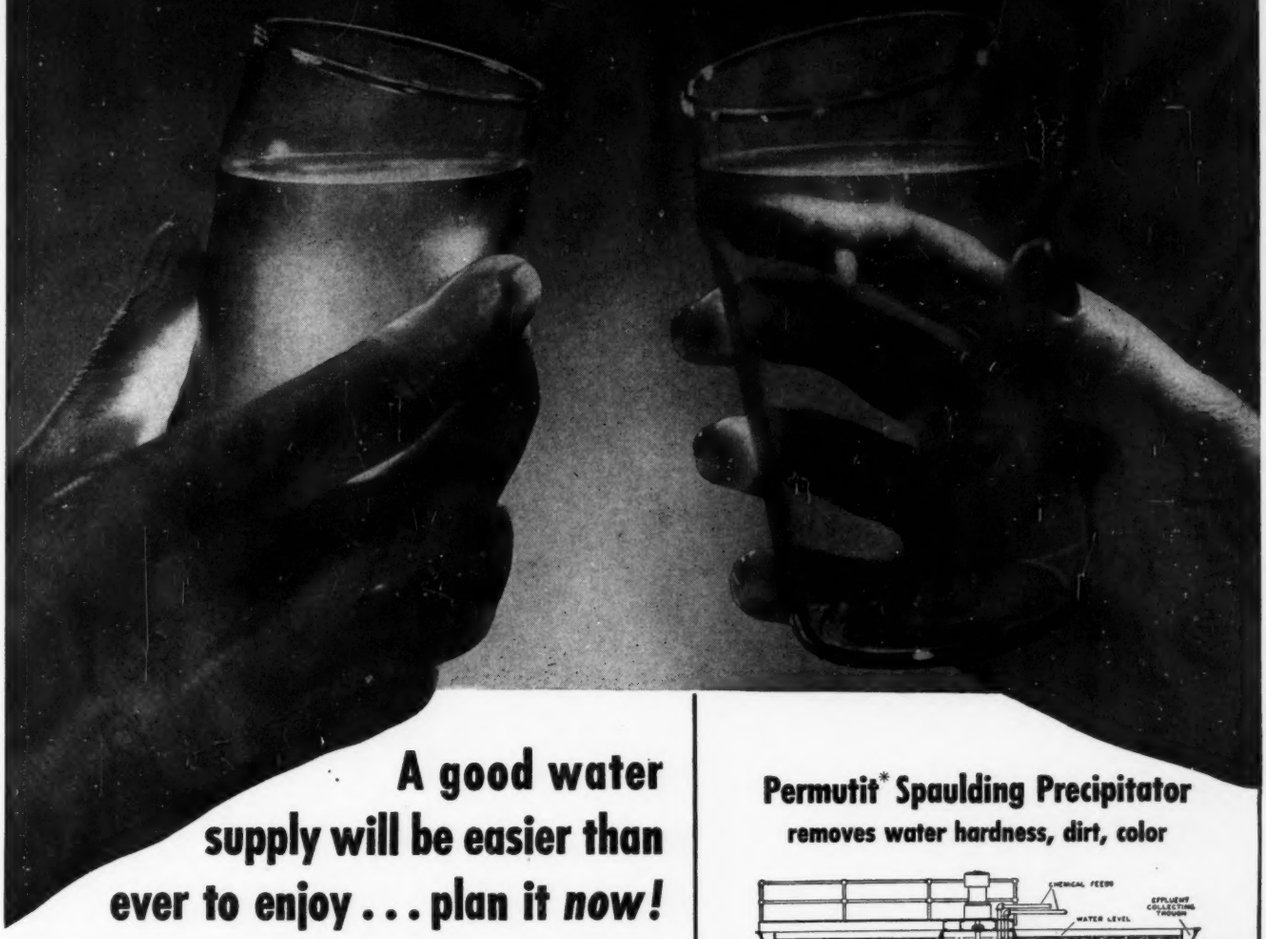
400 CHESTNUT STREET, PHILADELPHIA, PA.

ESTABLISHED IN 1803

Made by R.D. WOOD Company

MANUFACTURERS OF SAND SPUN PIPE (CENTRIFUGALLY CAST IN SAND MOLDS) AND R. D. WOOD GATE VALVES

To a happier future for your city—with soft, sparkling water!



A good water supply will be easier than ever to enjoy . . . plan it *now!*

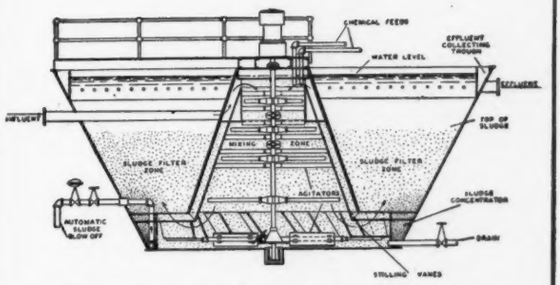
Good water—conditioned by Permutit—means happier, healthier homes, more prosperous business . . . as hundreds of modern municipalities have discovered. Now improved equipment makes it more practical than ever. After the war, few communities will be willing to put up with hard, turbid water. Be ready for this public improvement . . . plan it now! Write for booklet to The Permutit Company, Dept. G1, 330 West 42nd Street, New York, N. Y. In Canada: Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto . . . Winnipeg . . . Calgary.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

Permutit* Spaulding Precipitator

removes water hardness, dirt, color



This new type of equipment is revolutionizing cold lime soda treatment. It occupies only half the space of old-style plants! It cuts detention periods as low as one-eighth of former time! It makes important savings in chemicals! Installations now in use handle capacities as high as 120,000,000 gallons daily! Find out how it can easily be adapted to your city's needs.

*Trademark Reg. U. S. Pat. Off.

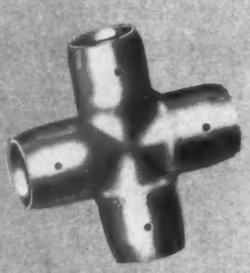
25 YEARS OF PROVIDING THE EAGLE WITH CLAWS!

. . . . . AND TWENTY-FIVE YEARS OF ACCUMULATED "KNOW HOW" IN THE MANUFACTURE OF MUNITIONS FOR UNCLE SAM AND . . . . . OF PROVIDING OUR GOOD CUSTOMERS WITH QUALITY BRASS AND COPPER PRODUCTS.

TWENTY-FIVE YEARS AGO THIS FACTORY WAS WORKING ENTIRELY FOR UNCLE SAM—in fact, our country's need in the first World War was the very reason for our birth and existence. TODAY WE ARE AGAIN WORKING 100% TO SUPPLY WAR MATERIALS FOR OUR ARMED FORCES—AND DURING ALL THE YEARS BETWEEN THE FIRST AND SECOND WORLD WAR IN WHICH WE WERE BUILDING A LARGE DOMESTIC BUSINESS, WE ALSO CONTINUED TO SUPPLY ORDNANCE MATERIAL FOR UNCLE SAM'S NAVY.

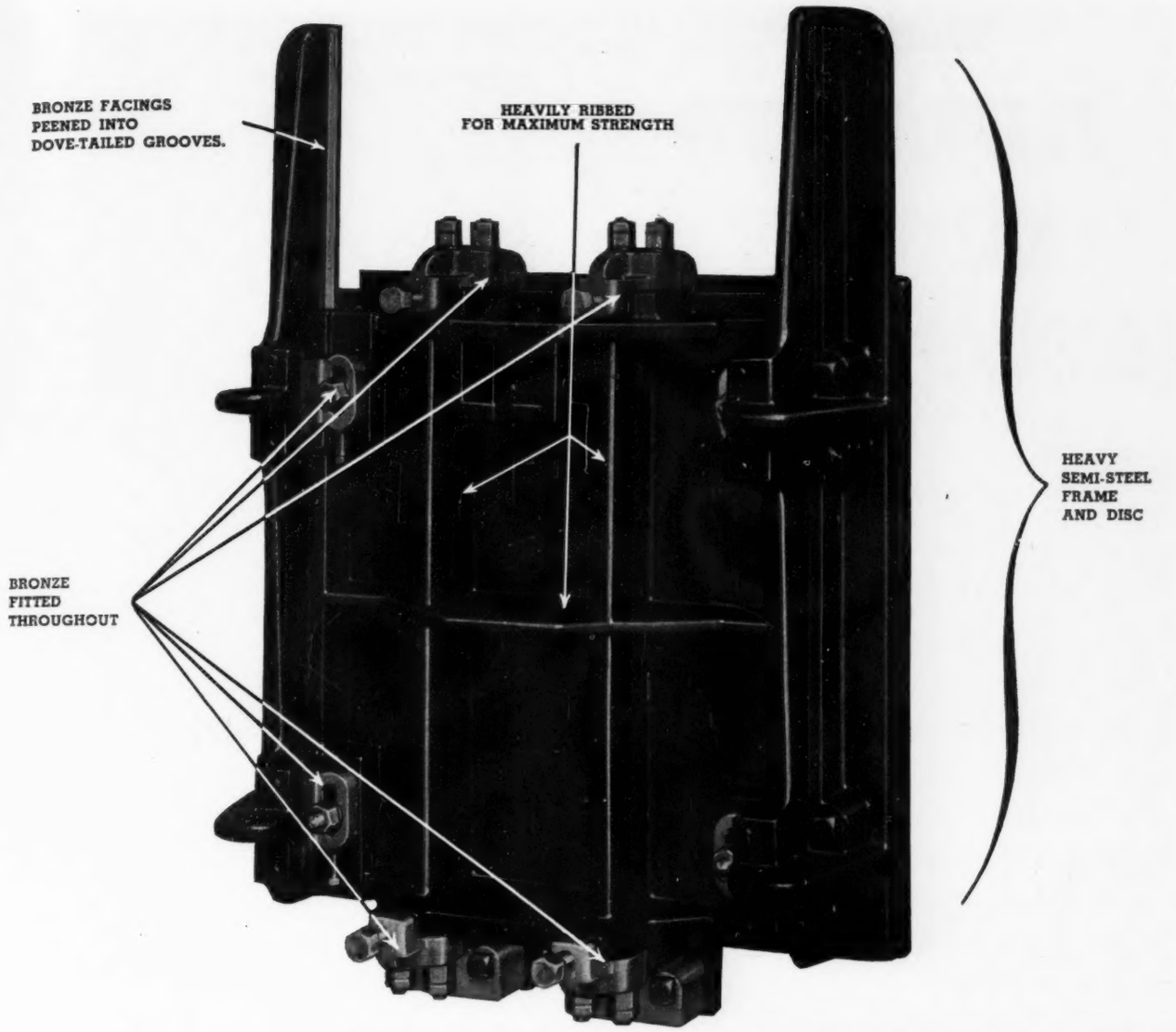
STREAMLINE Copper Pipe and Fittings are now in the service of our country for many purposes. They are installed in naval vessels of practically all types including victory ships, sub chasers, submarines, mine sweepers, etc. They are used for plumbing, heating, refrigeration, air conditioning, oil lines and a multitude of other services afloat and ashore.

On this our TWENTY-FIFTH ANNIVERSARY, we dedicate ourselves to an all-out effort for war . . . knowing that only through the winning of it can we gain a lasting peace. When peace returns to the world, we can regain those businesses of which we are now temporarily deprived, and STREAMLINE Copper Pipe and Fittings will once more protect the health of the nation as they are now protecting the health and lives of our men in the service.



We Proudly Fly the Army-Navy "E" for Excellence and Timely Production of Ordnance Material.

STREAMLINE
PIPE AND FITTINGS DIVISION
MUELLER BRASS CO.
PORT HURON, MICHIGAN



WATCH-LIKE PRECISION IN THIS HEAVY DUTY SLUICE GATE

A TOUGH VALVE FOR TOUGH SPOTS

A complete line of gate valves for Water Works installations. National Gate Valves are built strictly in accordance with the full specifications of the American Water Works Association and backed by a half century of engineering and manufacturing this type of equipment. Special constructions to suit your own particular needs will be developed promptly by our engineering staff. Write for information and estimates.

In National Sluice Gates you'll find an ideal combination of giant strength and smoothly precise operation. Against all usual pressure heads, these gates open and close easily without chattering.

Heavy, over-size construction is backed-up by careful machining and fitting of all sliding or screw parts. Wherever corrosive action might affect operation, only bronze is employed. Gate stems are of sufficient size to safely transmit the entire thrust due to opening or closing the gate under maximum operating head. Bronze wedges seat the gate firmly when closed, but free easily when the stem is turned to open the gate.

All together, here is a sluice gate which can really carry the load . . . and do it for years on end. Send for literature.

NATIONAL
MACHINE WORKS

1559 N. Sheffield Ave. Chicago, Ill.

BULLETS WON'T STOP 'EM—

BUT HTH WILL!

AMONG the deadliest enemies of U. S. troops are *water-borne diseases*. Invisible killers — whose "combat divisions" run into the billions! They spread typhoid, dysentery and other epidemics that can cripple or wipe out an entire army. But thanks to the skill and industry of the Medical Intelligence Division of the United States Army, our troops can take the field well prepared to combat these unseen assassins.

Potent weapon in the battle against bacteria is Mathieson HTH and other dry chlorine carriers. These quick-acting bactericides are the active sanitation principle employed by the Army's portable water purification units. When added to water, they release germ-killing chlorine — making the water safe to drink!

HTH is also used to purify drinking water at training centers and other military establishments. Additional quantities of HTH are required to flush water mains before they are put into use . . . and to render the disposal of sewage safe and sanitary.

U. S. Army portable water purification unit in action on the bank of a stream. In the circle, at the left of the chlorinator, a 5-lb. can of Mathieson HTH "in service"! (Photo #130812, U. S. Army Signal Corps).

As a result of its importance in safeguarding the health of our armed forces, the distribution of calcium hypochlorite is now rigidly controlled by the W. P. B. That means Mathieson must give our armed services first call on available supplies. But it also means that the U. S. isn't taking any chances with disease germs — the greatest leveller of armies the world has ever known!

THE Mathieson Alkali Works (INC)

60 E 42ND ST NEW YORK N Y

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

In WAR..as in PEACE..

HORTON ELEVATED STORAGE helps...
GUARD public health
PROVIDE emergency service in case of temporary power failure.
INSURE better public fire protection
CONSERVE electricity
• This attractive 1,000,000-gal. Horton radial-cone bottom tank is serving the city of Beaumont, Texas.

CHICAGO BRIDGE & IRON COMPANY

BIRMINGHAM • CHICAGO • CLEVELAND • DETROIT • HAVANA • HOUSTON
NEW YORK • PHILADELPHIA • SAN FRANCISCO • TULSA • WASHINGTON

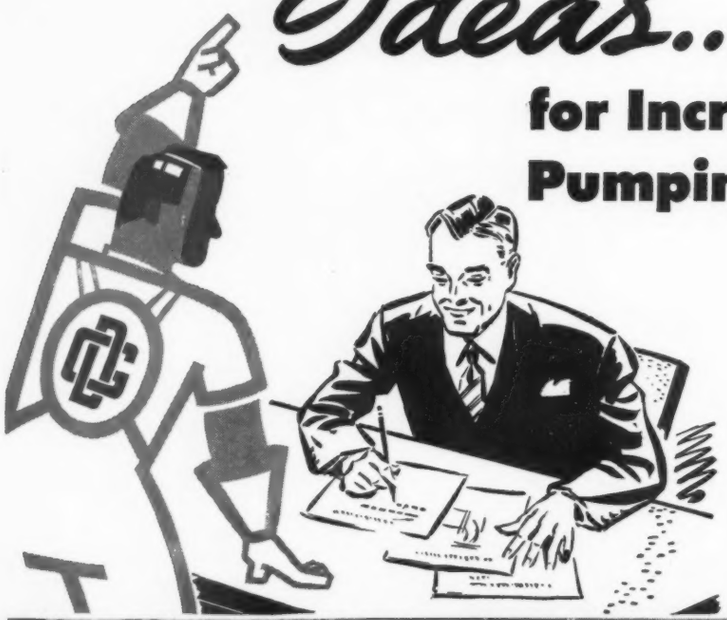
Extra ruggedness for continuous, large capacity pumping at heads up to 350 feet—Gardner-Denver Double-Suction Horizontally Split Case Centrifugal Pump.

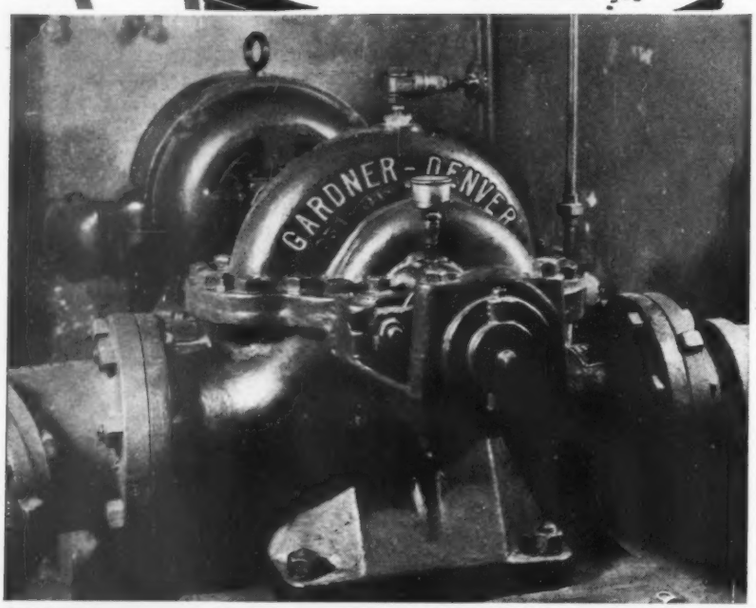
Simplicity of design for dependable service—1500 to 1600 gallons per minute at heads up to 100 feet—Gardner-Denver Side-Suction Centrifugal Pump.

A compact unit for installing in any position—capacities from 30 to 1200 gallons per minute at heads up to 300 feet—Gardner-Denver Close-Coupled Centrifugal Pump.

Ideas...

for Increasing Tomorrow's Pumping Efficiency





DESIGN will count for a lot in the world of tomorrow.

In centrifugal pumps, that means combining the most modern hydraulic and mechanical advantages for increased pumping efficiency.

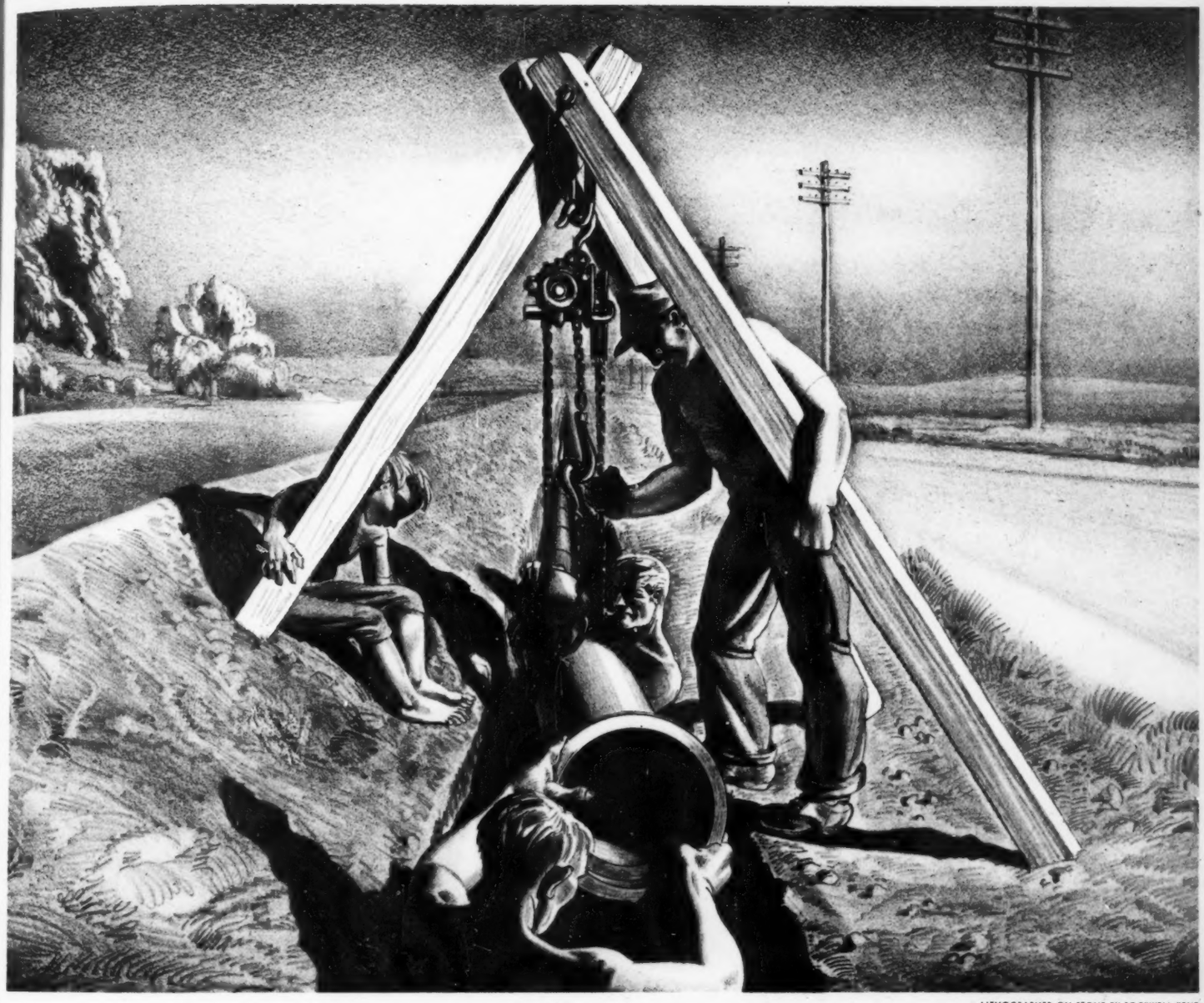
Gardner-Denver Company has always given careful attention to correct centrifugal pump design, with the result that Gardner-Denver centrifugals are truly modern, highly efficient units that fit into your pumping plans for today and tomorrow.

Their rugged frames—their accurate impeller and casing design—their properly proportioned water passages—have all been proved with reliable and accurate testing equipment in Gardner-Denver's completely equipped testing laboratories.

For bulletins describing Gardner-Denver centrifugal pumps, write Gardner-Denver Company, Quincy, Illinois

GARDNER-DENVER PRODUCTS HELP SPEED VICTORY

GARDNER-DENVER *Since 1859*

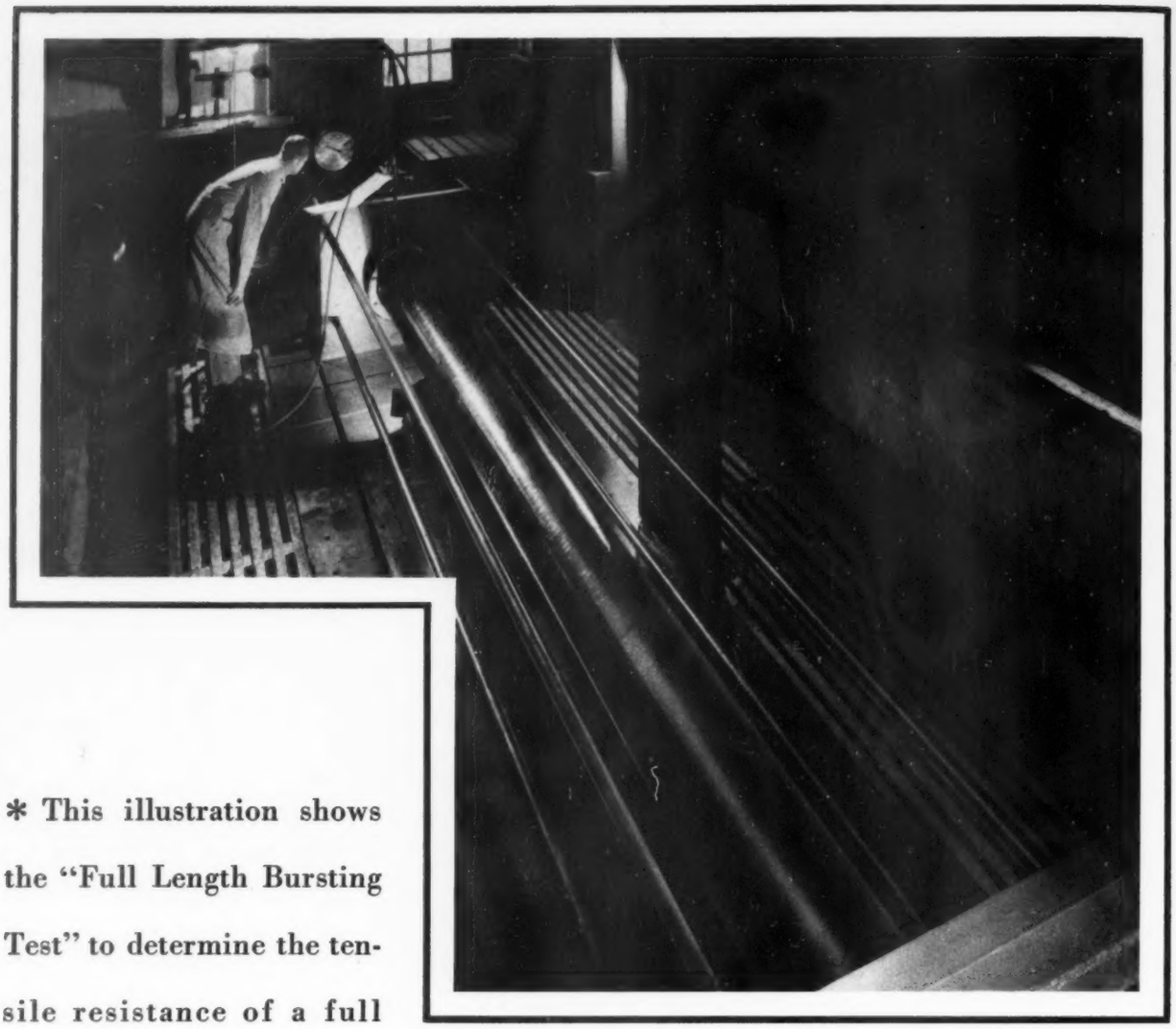


LITHOGRAPHED ON STONE BY ROCKWELL KENT

UNITED STATES PIPE AND FOUNDRY COMPANY

BURLINGTON, NEW JERSEY

America's Largest Producer of Cast Iron Pipe for Water, Gas, Sewerage, Drainage and Industrial Service

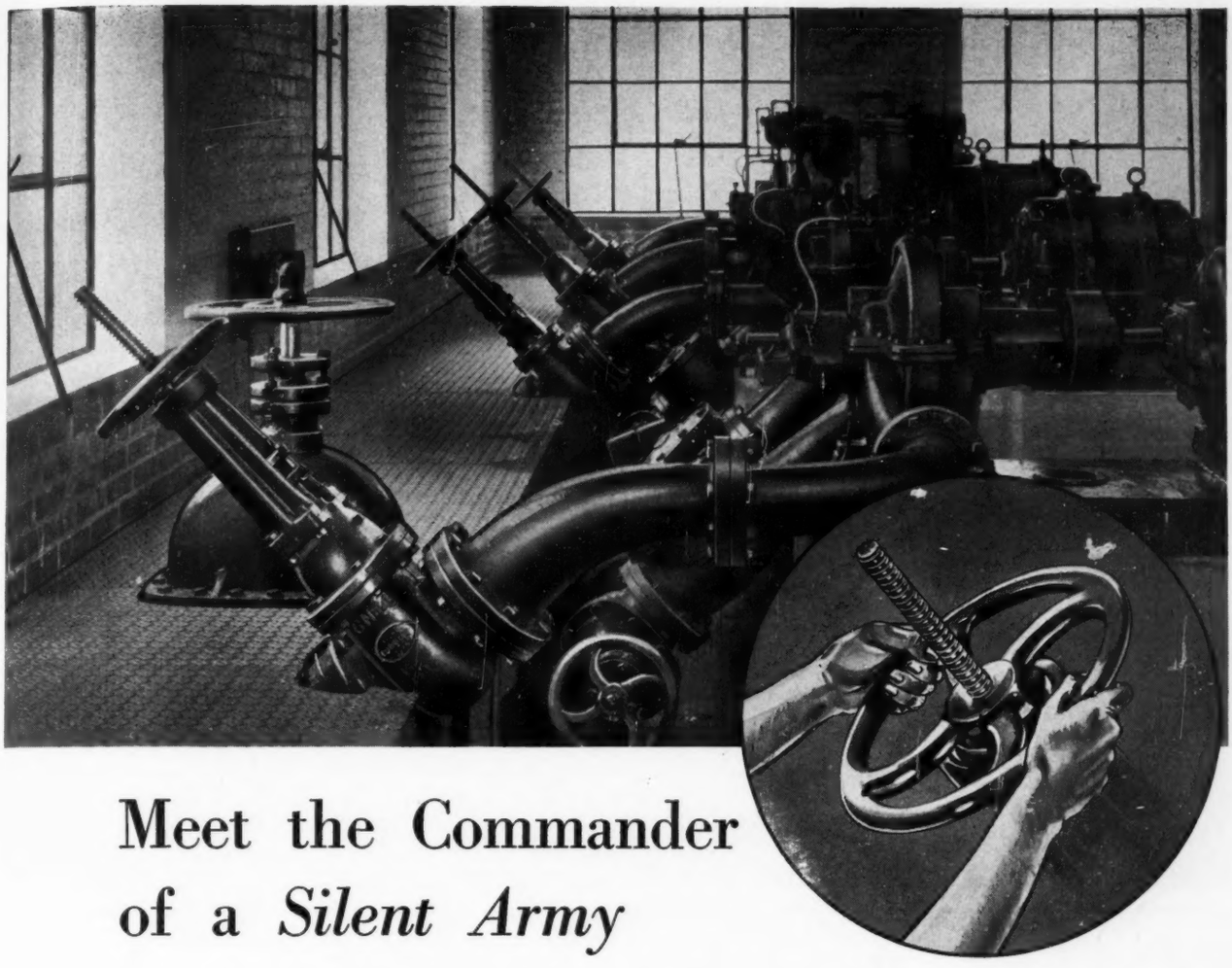


* This illustration shows the "Full Length Bursting Test" to determine the tensile resistance of a full length of pipe. The pipe is subjected to progressively increased hydrostatic pressure until failure occurs. Although not a required acceptance test, it is one of the additional tests regularly made by this Company to further check and maintain the quality of its pipe so that it will adequately meet severe service requirements.

* One of a series of controls in operation at each of our plants, beginning with inspection and analysis of raw materials and ending with tests of the finished product, all subject to the central control of our headquarters staff at Burlington.

U.S.
cast iron
PIPE

Centrifugally or Pit Cast for water, gas, sewerage, drainage and industrial services.



Meet the Commander of a *Silent Army*

These hands control the actions of a mute army of soldiers. They wear no uniforms, require no pay. Yet they are always at their stations, ready for instant action — and upon them may depend the fate of the community!

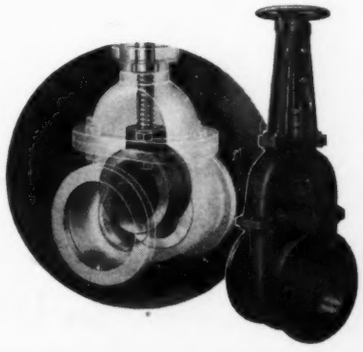
These silent soldiers comprise the network of Ludlow Valves at the pump house and throughout the water works system — ready to respond quickly and efficiently in routine or emergency.

Ludlow Valves employ the famous double-disc, parallel seat principle, developed and perfected by Ludlow over a period of three-quarters of a century. This system assures easy operation and positive closure — even after years in the open position.

THE LUDLOW VALVE MFG. CO., INC.

TROY, NEW YORK

Construction Features: Self-releasing 30° angle wedges and free-floating gates, self-adjusting to seats, afford smooth, trouble-free performance, long service. Rings are cleaned throughout stroke action. Gates are wedge-locked directly opposite ports and completely unwedged before raising. Ample tolerances provide easy action. Simple construction permits easy replacement of parts.



LUDLOW VALVES

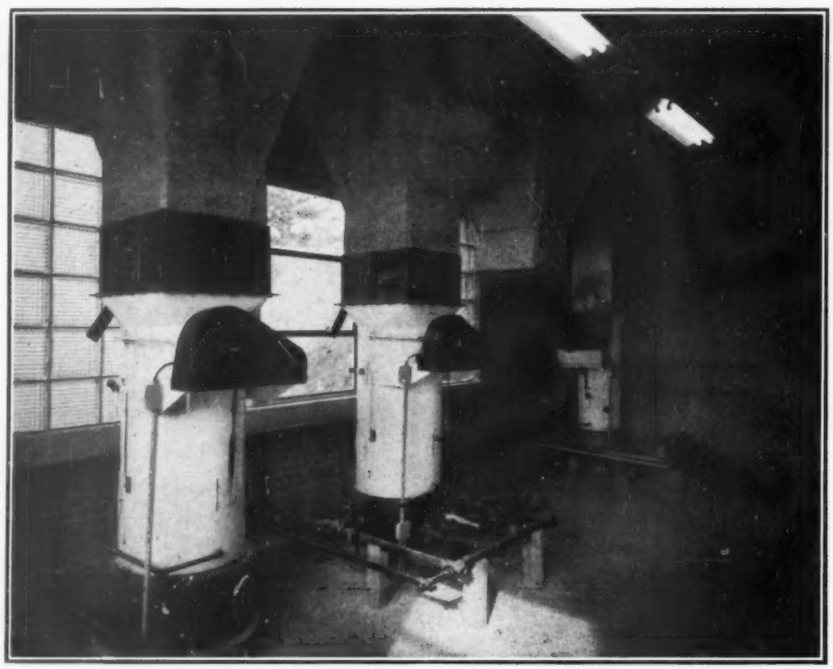
SINCE 1866

It's a Cinch to Clean Sewers this Fast, Easy FLEXIBLE Way!
LET MINUTES OF EASY WORK TAKE THE PLACE OF HOURS OF TOIL
Here's the modern way to clean sewers – Eliminate 90% of your sewer dig-ups. Cut out the backbreaking toil of the old, out-moded methods.
Join the thousands of enthusiastic FLEXIBLE users from Coast to Coast.
Write for special descriptive catalog and instruction manual explaining the Whys and Wherefores of FLEXIBLE'S big time- and money-saving record.

FLEXIBLE SEWER-ROD EQUIPMENT CO.

9059 VENICE BOULEVARD, LOS ANGELES, CALIFORNIA
401 BROADWAY, NEW YORK, N. Y. • PICKWICK BLDG., KANSAS CITY, MO.

OMEGA at Newport News, Va.



The illustration shows three OMEGA Chemical Feeders at the new Filtration Plant of Newport News, Virginia.

OMEGA Gravimetric Feeders are saving construction and Chemical handling costs in many plants.

OMEGA MACHINE CO., 3409 E. 18th St., Kansas City, Mo.

WATER PURIFICATION

"—vital to civilian defense—"

TODAY—*more than ever before*—
YOU NEED THE DEPENDABLE PURITY, UNIFORMITY AND QUALITY OF . . .

DIAMOND *Liquid* CHLORINE

BECAUSE Diamond Liquid Chlorine is made under rigid supervision and checked at frequent intervals during manufacture, you can rely absolutely on its uniformly high quality.

As a further guarantee of satisfaction, Diamond Liquid Chlorine always comes to you in tested containers of the type best suited to your requirements. For large users, 16- and 30-ton tank cars are provided; for moderate users, a multi-unit car delivers 15 one-ton containers; for smaller users, Diamond warehouses furnish 100-pound and 150-pound steel cylinders.

To make sure that *your* Liquid Chlorine is uniform, pure, dependable — SPECIFY DIAMOND!

DIAMOND ALKALI CO.
PITTSBURGH, PA., *and Everywhere*

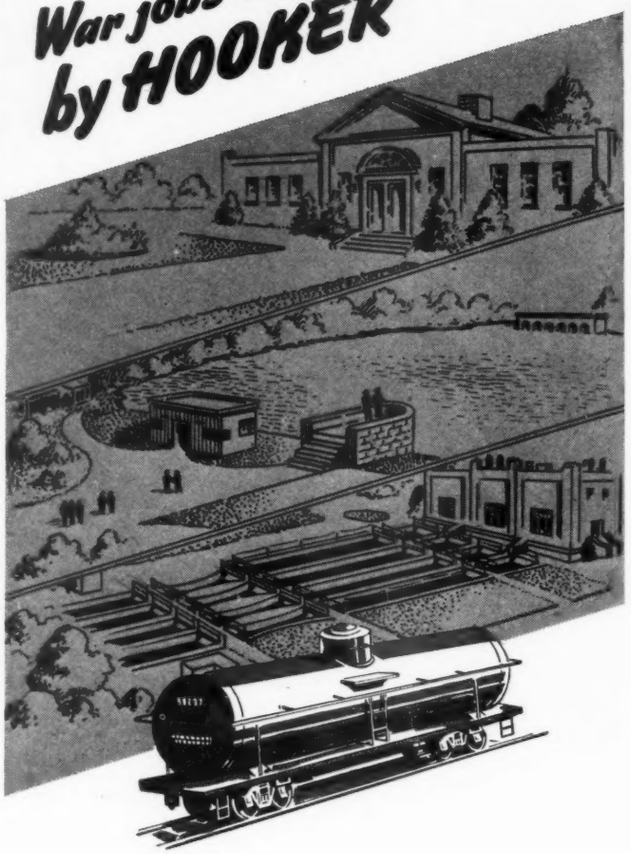
In response to demands for plain facts...

Simplex Bulletin 250 puts at your finger tips detailed dimensional data necessary for design and specification purposes.

SIMPLEX METERS
THE METER WITH THE ROLL SHAPED FLOAT

SIMPLEX VALVE & METER CO.
6743 Upland Street • Philadelphia, Pa.

War jobs helped by **HOOKER**



New sanitary problems

Mushrooming populations, civilian defense, military requirements, changing health department standards—these and many other new war-time sanitary problems create for chemists added responsibilities—lightened materially by

HOOKER Chemicals

HIGHEST standards of purity and rigid adherence to specifications have distinguished HOOKER chemicals for decades. These characteristics are meticulously guarded today in the face of unprecedented demands for quantity. Among the more than four-score HOOKER quality chemicals are Liquid Chlorine, Caustic Soda, and Ferric Chloride Solution.

HOOKER technical specialists are available for consultation on any chemical problems.

3364

88 years OF PROGRESSIVE STORAGE TANK ENGINEERING!

Established in 1854, the R. D. Cole Mfg. Co. has long been recognized as one of the nation's outstanding tank builders. With 88 years of "progressive storage tank experience" at your disposal, we will welcome the opportunity to serve your tank needs.

ALL SHAPES AND SIZES

The R. D. Cole Mfg. Co. has developed a complete line of elevated steel tanks for water supply, both for domestic service, and sprinkler requirements, ranging in capacity from 5,000 to 2,000,000 gallons. The designs include the standard Hemispherical and Self-supporting bottom, the "Cole Ovaloid", Standpipe, and many individual styles involving architectural treatment to satisfy local conditions, or to provide special shapes for advertising purposes.

STORAGE TANKS

Pressure tanks for storage of gas from digestors at sewage disposal plants so that excess output at peak loads can be used during off-peak periods. Chemical storage tanks, hot water storage tanks, tanks for bulk storage of oils and gas.

CONSTRUCTION FACILITIES

Fabricated steel plate—the R. D. Cole Mfg. Co. has a fully equipped plant for the fabrication of riveted or welded steel plate. In addition to the construction of its regular line of horizontal return tubular boilers, oil storage tanks, tubular heaters, etc., the company is prepared to construct special tanks and apparatus of any specified metal plate.

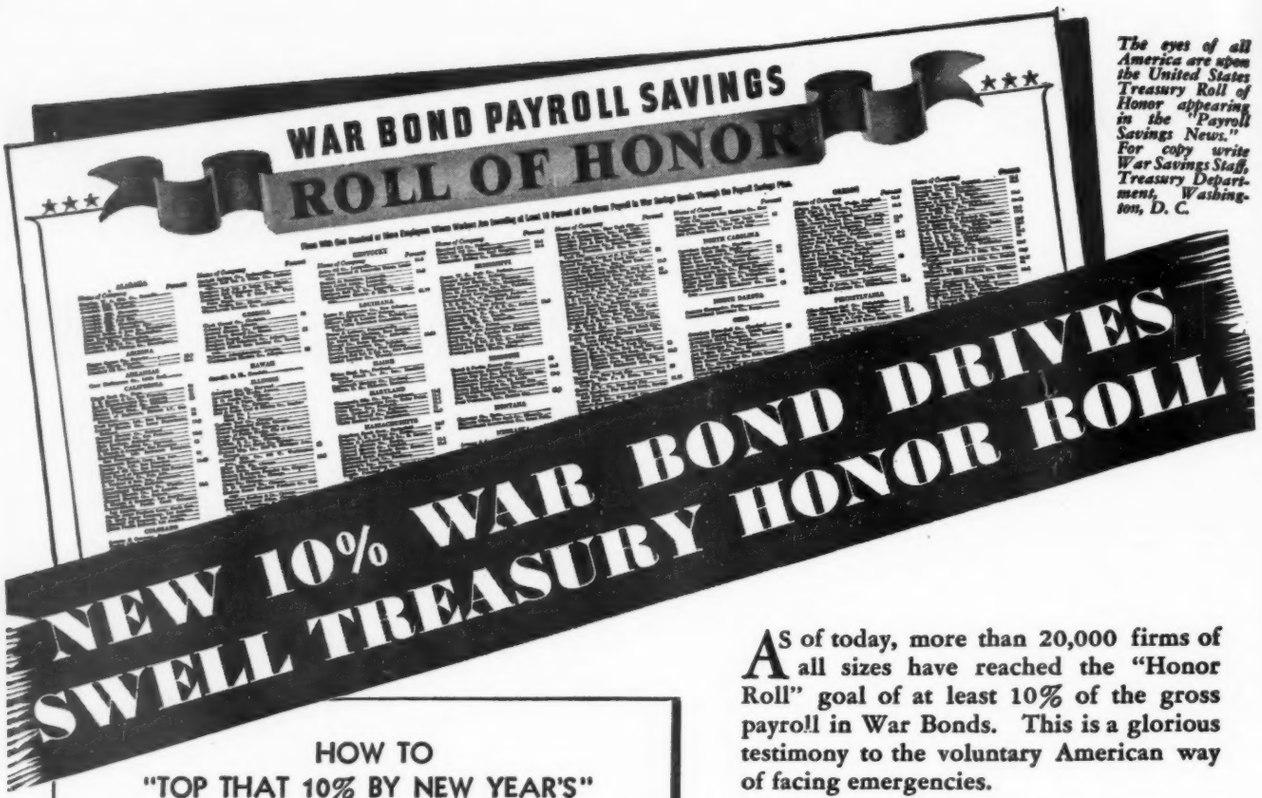
1,000,000-Gallon "Cole-Shallow Depth" Tank

Designs available for any service, made to your specifications or from our designs submitted by our own Engineering Department.

R. D. COLE MANUFACTURING CO.

Established in 1854

NEWNAN « « GEORGIA



The eyes of all America are upon the United States Treasury Roll of Honor appearing in the "Payroll Savings News." For copy write War Savings Staff, Treasury Department, Washington, D. C.

HOW TO "TOP THAT 10% BY NEW YEAR'S"

Out of the 13 labor-management conferences sponsored by the National Committee for Payroll Savings and conducted by the Treasury Department throughout the Nation has come this formula for reaching the 10% of gross payroll War Bond objective:

1. ***Decide to get 10%.***
   It has been the Treasury experience wherever management and labor have gotten together and decided the job could be done, the job was done.
2. ***Get a committee of labor and management to work out details for solicitation.***
   a. They, in turn, will appoint captain-leaders or chairmen who will be responsible for actual solicitation of no more than 10 workers.
   b. A card should be prepared for each and every worker with his name on it.
   c. An estimate should be made of the possible amount each worker can set aside so that an "over-all" of 10% is achieved. Some may not be able to set aside 10%, others can save more.
3. ***Set aside a date to start the drive.***
4. ***There should be little or no time between the announcement of the drive and the drive itself.***
   The drive should last not over 1 week.
5. The opening of the drive may be through a talk, a rally, or just a plain announcement in each department.
6. Schedule competition between departments; show progress charts daily.
7. Set as a goal the Treasury flag with a "T."

As of today, more than 20,000 firms of all sizes have reached the "Honor Roll" goal of at least 10% of the gross payroll in War Bonds. This is a glorious testimony to the voluntary American way of facing emergencies.

But there is still more to be done. By January 1st, 1943, the Treasury hopes to raise participation from the present total of around 20,000,000 employees investing an average of 8% of earnings to over 30,000,000 investing an average of at least 10% of earnings in War Bonds.

You are urged to set your own sights accordingly and to do all in your power to start the new year on the Roll of Honor, to give War Bonds for bonuses, and to purchase up to the limit, both personally and as a company, of Series F and G Bonds. (Remember that the new limitation of purchases of F and G Bonds in any one calendar year has been increased from $50,000 to $100,000.)

TIME IS SHORT. Our country is counting on you to—

"TOP THAT 10% BY NEW YEAR'S"

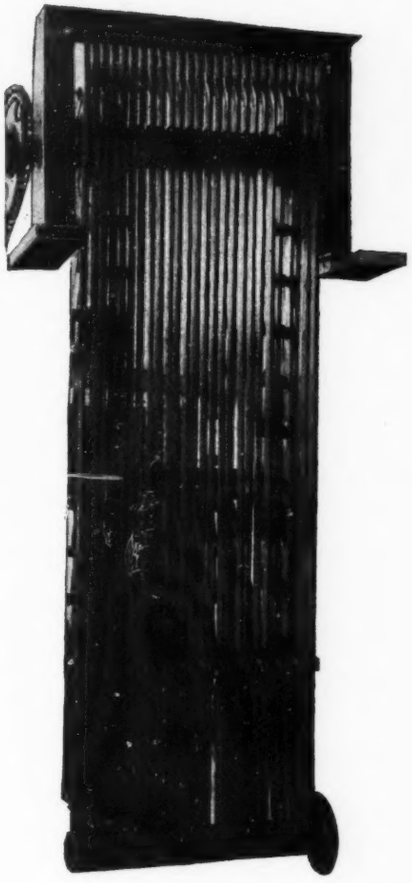
EVERYBODY EVERY PAYDAY AT LEAST 10%

Save with War Savings Bonds

This space is a Contribution to America's All-Out War Effort by WATER WORKS AND SEWERAGE

"AMERICAN" PUMP SCREEN

MECHANICAL TYPE



Installation showing upstream side of screen and suction pipe

SELF SHARPENING—The hollow ground cutting impeller is self sharpening and does not require constant care to keep the screening device from flooding out.

RANGE—This bar screen will handle the greatest range in flow without effecting operating conditions.

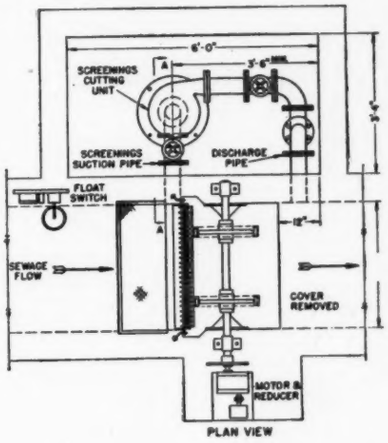
DEPENDABILITY—Power failures do not throw the screen out of operation as the screening action does not depend alone upon the operation of the cutter.

SIMPLICITY—The cutting impeller is a simple unit that may be easily removed for inspection and resharpens itself until the very hard metal on the cutting edges is gone.

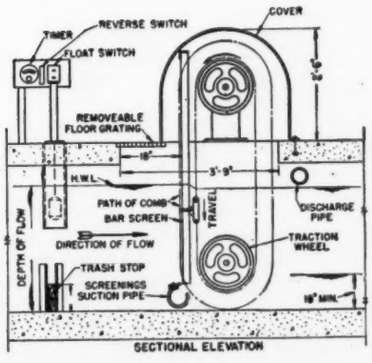
LONGEVITY—The cutting operation, being intermittent, is confined to less than two percent of time per day.

ECONOMICAL OPERATION—Altho the motor driving the cutting pump is relatively large, its total energy consumption is small because it operates less than 2 percent of time per day.

Cutting Impeller



PLAN VIEW



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is a working combination of a bar screen and cutting pump. Solids are screened from the sewage, discharged from the screen to suction trough of cutting pump, cut into fine particles and passed on with the sewage.

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AURORA ILLINOIS

MANUFACTURERS OF

Pumping,—Sewage Treatment,—

and Water Purification Equipment

—CORRECTION—

Pardon us—it's our mistake not the magazine's

% Proportioneers % made the following statement in an ad in Water Works & Sewerage, P. 22, November, 1942, issue: "When you install the permanent water pump probably of larger size, move the Chlor-O-Feeder to the new system and cross-connect it on the permanent pump providing it is small enough to permit hypochlorination (under 1,000,000 gal. per day ***or under 750 gpm).***" We want to correct any ***misconception that seven hundred and fifty gallons per minute is the maximum flow that can be economically hypochlorinated.*** 750 gpm was used only as a conservative average figure ***based on 24 hours' continuous pumping.*** Hundreds of water plants are hypochlorinating in excess of 750 gpm. It is not uncommon to hypochlorinate 1500 gpm, 2000 gpm and even higher where pumps are operated only 3, 5, or 10 hours per day. The economical limits of hypochlorination are determined by:

(1) The amount of water pumped daily or, in some instances, annually (Outdoor swim pools, camps, and other water systems not used 12 months of the year).

(2) The type of water system (gravity or pumped—variable flow or constant rate).

(3) The cost of chlorine in form of hypochlorite at your plant.

(4) The chlorine dosage needed to produce the required residual in your water.

(5) Is the installation permanent or only an emergency measure "for the duration"?

(6) First cost; (last but not least, the cost of recommended gas chlorination equipment is, frequently, a determining factor).

With so many variables it is impossible to set a maximum figure beyond which hypochlorination should not be considered and hence when we set a figure such as 750 gpm it should be considered not as a top maximum for hypo but as a point where gas begins to merit consideration if based on 24-hour continuous pumping. Close calculation will permit decision as to propriety of using "Hypo or Gas."

We also want to correct any misconception that % Proportioneers % Chlor-O-Feeders bought as chlorinators for temporary water supplies can ***only*** be used for chlorination. It is true, as stated in our November ad in Water Works & Sewerage Magazine, that hundreds of Chlor-O-Feedrs have been bought as chlorinators for temporary water supplies and because of large Chlor-O-Feeder capacity (over 200 lbs. Cl_2 per day) were later installed as standby chlorinators to augment gas chlorinators during high demand conditions or to replace the gas chlorinator during repair periods. In addition, other hundreds of Chlor-O-Feeders bought for temporary chlorination are now feeding Aqua-Ammonia, "Calgon," Soda Ash, Alum, or any other water works chemicals.

In summary, we recommend that careful consideration be given to all the pertinent data before issuing "specs" for purchase of chlorination equipment. Better yet, let us have a representative assist you in analyzing your problem.

% PROPORTIONEERS, INC. %

Write "Emergency Chemical Feeder Headquarters" Today

9N CODDING STREET **PROVIDENCE, R. I.**

WATER WORKS & SEWERAGE

PUBLICATION OFFICE
330 South Wells Street, Chicago, Ill.
E. S. Gillette, Publisher

EDITORIAL OFFICE
155 East 44th Street, New York, N. Y.
L. H. Enslow, Editor

COMING!

Annual Progress Reviews
Water Supply Developments of 1942
Reviewed by—
VICTOR WEIR,
Engineer and Superintendent,
St. Louis County Water Co.

To Mr. Weir we are especially indebted, since he stepped into a breach at the last minute when the U. S. Navy out-ranked Water Works and Sewerage in its demands on the services of Sam Morris, Dean of Engineering at Stanford, and Vice-President of A.W.W.A., who had the review job underway. An S.O.S. by wire to "Wheelhorse" Weir brought a happy—"I'll do my best on the short notice." This was sufficient for us, for we know our man from past performance.

Sewerage Developments of 1942
Reviewed by—
PROF. CHARLES GILMAN HYDE
University of California
and
A. M. RAWN, Chief Engineer,
Los Angeles County Sanitation Districts
(Associate Editor, Water Works and Sewerage)

Those who have read previous reviews by Professor Hyde and the reports and articles of "A.M.R." in this magazine will know what to expect in our February issue. We feel extremely happy in this difficult year to be able to give our readers such a brace of reviewers.

"Re-establishing the Designed Capacity of a Vital Flow Line"

Is another one of those "stretch" stories involving a successful measure employed to restore the delivery capacity of a vital 36-mile transmission main called upon to supply military needs. The experience is another success story for chlorination, in which an heroic short term dosage stripped the 39-in. reinforced conduit of its flow impeding biological film. The account is told by—
L. A. JACKSON, Manager,
and
W. A. MAYHAN, Chemist,
Little Rock (Ark.) Water Works.

DIGESTER HEATING

On this important topic two articles by designing and operating engineers have been scheduled.

"Digestion Tank Heating—Theory and Practice"

Is a veritable treatise by a contributor whose articles are known to readers of "WATER WORKS AND SEWERAGE" for the study behind them and their exhaustive quality. The author is—
NORMAN C. WITTWER, Consultant,
Trenton, N. J.
(Former Supt. Rahway Valley Plant and now Captain, U. S. Engineers.)

"Digestion Tank Design for Efficient Gas Production"

Is a discussion of basic considerations in heated sludge digester design and the suggestion of an operator wherein heat conservation and the economics of digester gas production can most effectively be improved. The author is—
ALBERT B. KOZMA, Sup't,
Joint Meeting Treatment Plant, Rutherford, N. J.

"Biological Water Conditioning"

Is the interesting story of hardness precipitation by the plant Chara, which also performs another useful service in inhibiting algae growths. The report comes from—
HENRY C. MYERS, Chemist,
California Water and Tel. Co., Palm City, Calif.

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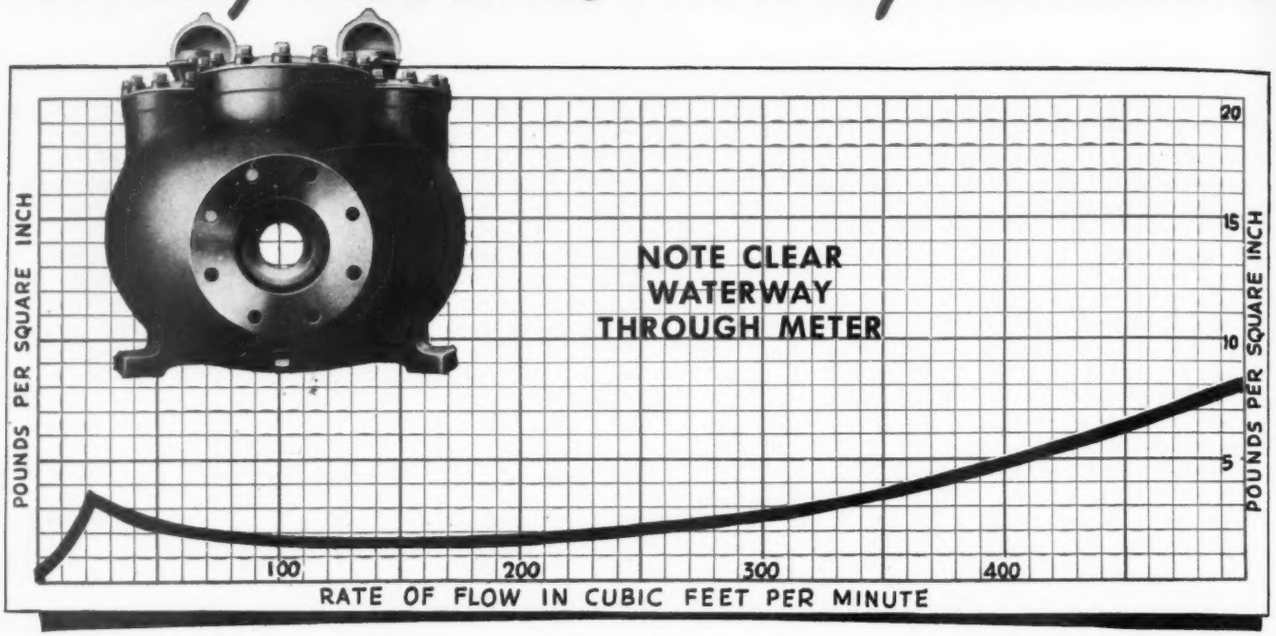

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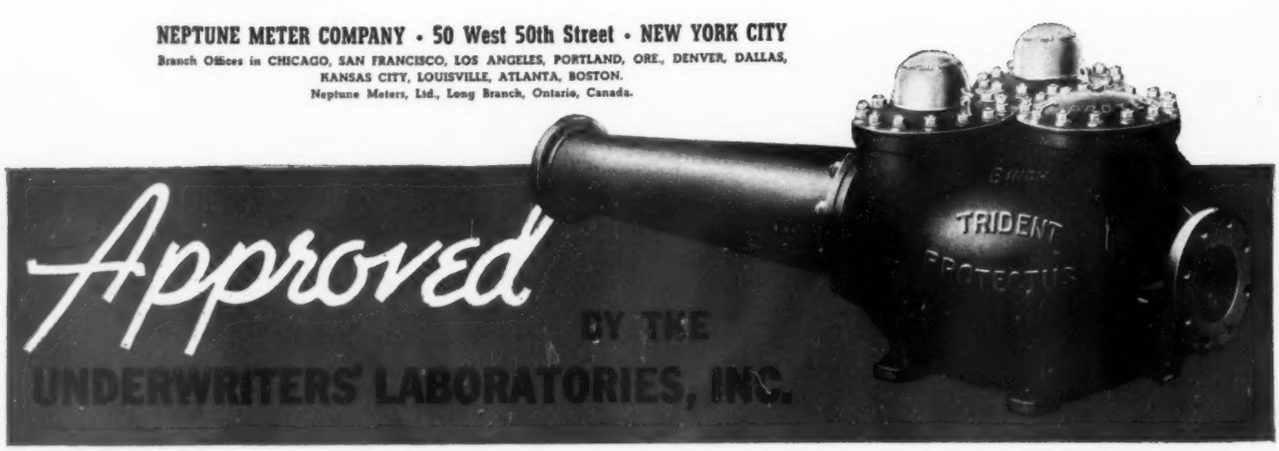


Approved BY THE UNDERWRITERS' LABORATORIES, INC.

WATER WORKS & SEWERAGE

VOL. 89, No. 12 *A Gillette Publication* DECEMBER, 1942

THE NEW FILTRATION PLANT OF NEWPORT NEWS, VA.

A Defense Project Speedily Put Under Construction With an A-3 Priority and Completed Under an AA-2X Rating

REEVES NEWSOM*
Engineer-Consultant
NEW YORK, N. Y.

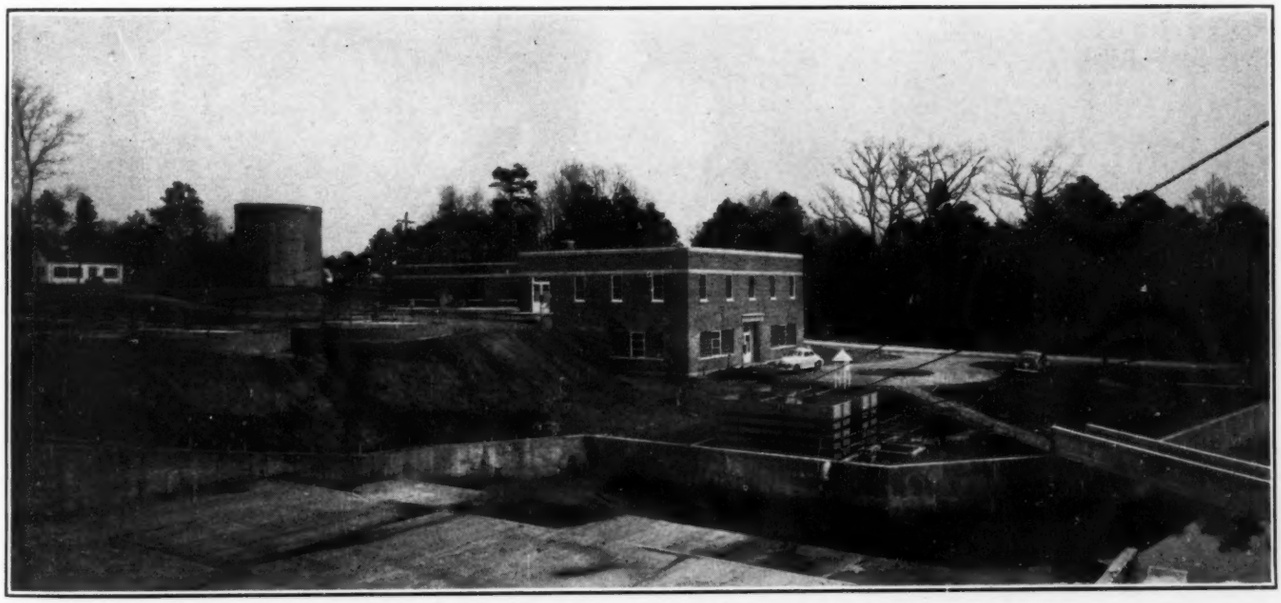
THE Harwood's Mill Filter Plant of the Newport News Waterworks was put in operation on September 30, 1942. It was the first major waterworks project under Defense Public Works constructed with funds largely provided by the Lanham Act.

The project included a 6.0 mgd. filter plant and pump station and roundly 17 miles of cast iron transmission lines from 30 to 12 inches in diameter. Bids were called for on October 5, 1941, the contract was awarded on November 10, and the work was begun just two days later. When started, the project carried an A-3 priority, which was ample at that time to get the work well underway. However, the priority spiral soon caught up and passed that rating and resultant difficulties, added to that of getting and holding labor adequate in amount and quality, were responsible for the original scheduled completion date being delayed some four months. Only a relatively few items held up getting the plant in operation weeks before, but they were vital and required a series of changes in priority ratings, finally reaching AA-2X before all could be obtained.

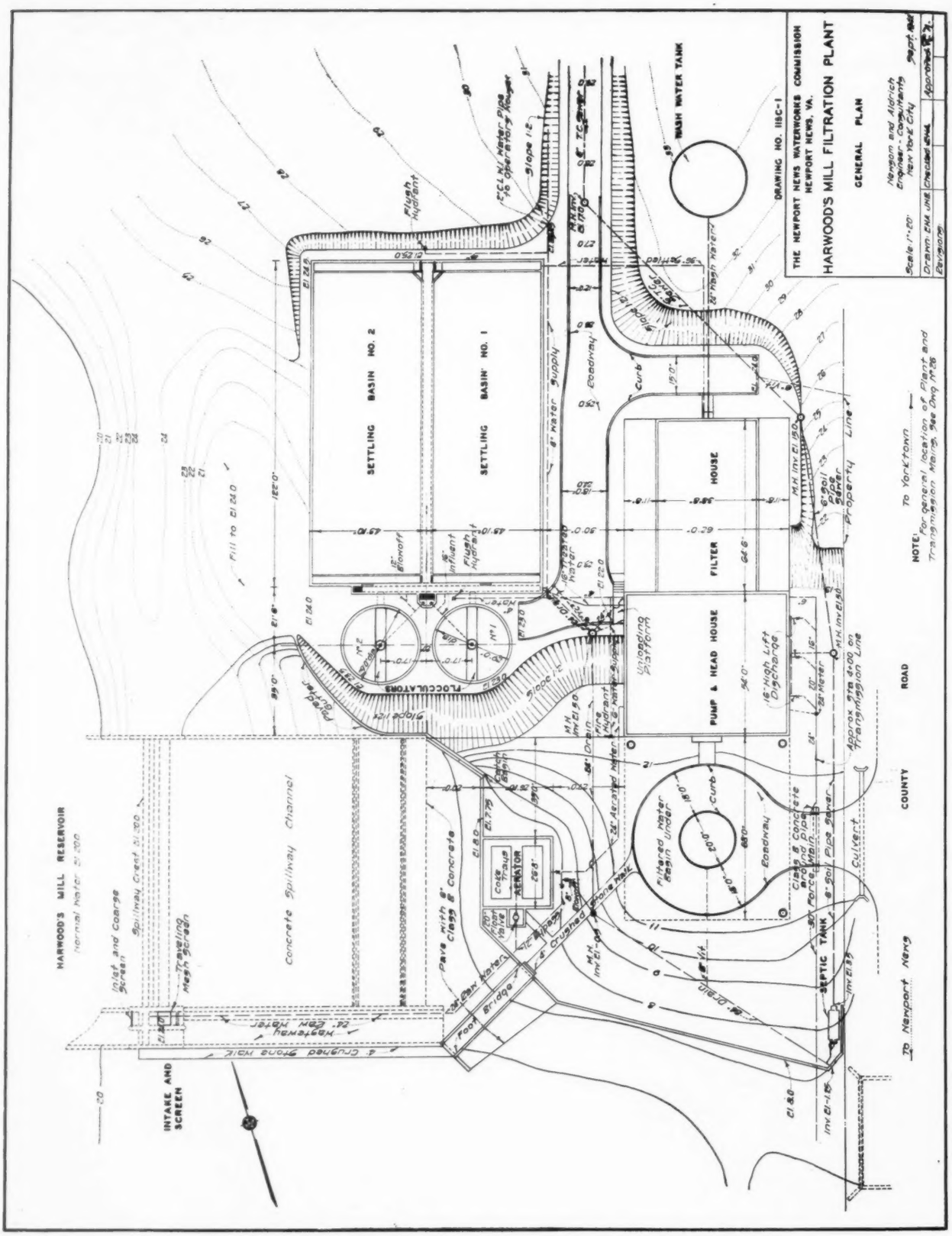
The Author

This filter plant is not unique because of new departures from past practice and the inclusion of the so-called latest developments coming out of experimentation which has been a continuing part of the art of water purification. Any claim it may have to being different lies rather in the fact that, contrary to most plants built in the last few years, it is a compact, effective, utilitarian appli-

* Of Newsom & Aldrich, Engineer-Consultants, New York and Williamsburg, Virginia.



General View of the Harwood's Mill Plant from the Spillway.



General Plan of the Harwood's Mill Filter Plant—Newport News, Va.

cation of the tried and conventional elements of filter plant design. Its simplicity and lack of ornateness, commodious lobbies and areaways does not mean that its vital elements and control equipment are not of the latest and most efficient type. On the contrary, its plain exterior, which by virtue of a small amount of architectural terra cotta and glass block just escapes looking like a mill building, houses protection against accidents to power lines and force mains equaled in few if any comparable plants.

In the early part of 1939 the water consumption of Newport News, which had been averaging around 4.5 mgd. for several years, began to climb. The demand was created by the beginning of what later developed into a tremendous growth in the activity of the Newport News Shipbuilding and Dry Dock Corp. Until late in 1940 the increased load was readily absorbed by the reserve capacity of the existing works. Toward the middle of the year the various "contrivings" that could be done with the equipment and mains available were largely exhausted. It became apparent that additional supply, filter, pumping and transmission facilities would be required and studies leading to their design were begun.

The System as It Stood

The supply and purification works of Newport News had consisted, ever since World War I, of three impounding reservoirs on adjacent watersheds, the largest one, the Lee Hall reservoir, being in the middle and having located below its dam, near Williamsburg, the filter plant and main pumping station. Leading from this pump station were two force mains, an 18-inch and a 24-inch, the latter becoming 30 inches at about the two-thirds point of its length, which connected to the distribution system and elevated storage about 16 miles distant.

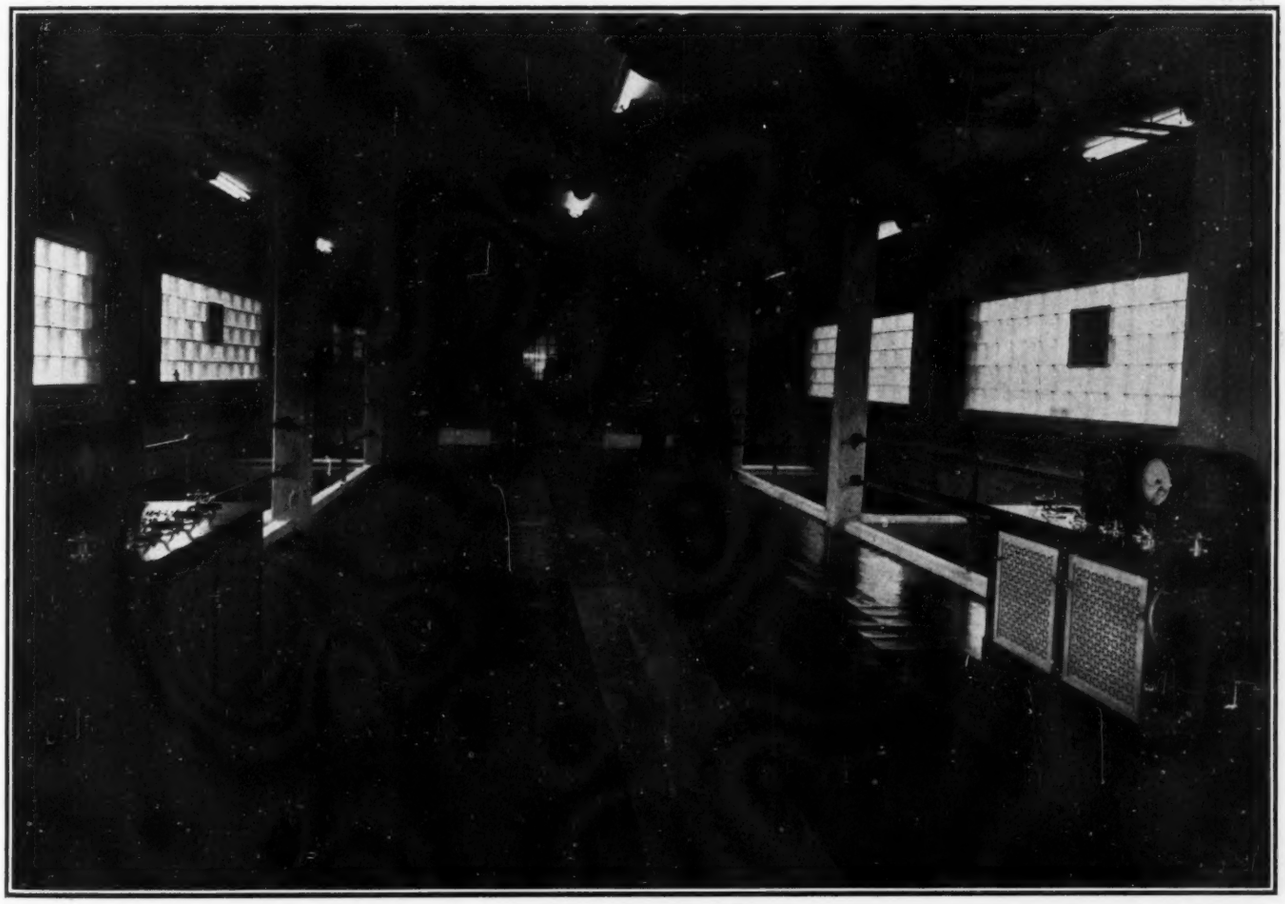
The water stored in the two side impounding reservoirs was pumped to the middle one. The discharge from the larger of the two, the Harwood's Mill reservoir, was through an open ditch and brook bed from the top of the divide, a distance of approximately 15,000 feet. At times of drought losses through this ditch approximated one-third of the pumpage from Harwood's Mill.

Studies indicated that if water from this reservoir were filtered and pumped directly to the city through a separate system of transmission mains, a material increase in the total yield of the combined reservoir watershed of 30 square miles would be obtained. This would result from eliminating the loss of water in transporting from one reservoir to another and by decreasing the loss over the spillway in the filling season, due to the increased flexibility from the two ways of pumping directly to the city.

Furthermore, the Newport News distribution system was an extended L-shaped system with the entire supply coming to it at the end of the short leg of the L. A separate system of transmission maines leading from additional pumps at a station on Harwood's Mill reservoir would not only make possible the furnishing of more water to the system, but the additional amount could be brought in near the end of the long leg of the L, thus materially improving service conditions at that end of the system where pressures were at times deficient.

Locating Additional Water

During World War I consideration had been given to bringing in water from the distant Chickahominy watershed had the war continued



The Filter Operating Floor

long enough. Without knowing in 1940 whether such a condition would again arise, it was clear from the studies of the conditions that if additional surface water ever did have to be obtained from another source, part of it would surely have to pass through a plant to be located at Harwood's Mill. Likewise, the duplication resulting from construction of a second system of transmission mains roughly parallel to but a few miles away from the single set then being used was of obvious advantage. The estimated peak load to be prepared for, as it appeared in the middle of 1940, was 12.0 mgd. The proposed filter plant and mains, as well as the existing set, each would be able to carry 75 per cent of that peak during a period of emergency repairs to the other.

The New Harwood's Mill Filter Plant

The Harwood's Mill filter plant comprises four 1.5 mgd. reinforced concrete filters, 1,000,000 gallons of settling basin capacity, 450,000 gallons of clear well capacity and a 150,000 gallon wash water standpipe. The pumping plant includes three low lift pumps of 2,200, 2,900 and 4,400 gpm. capacity and three high lift pumps of 2,100, 2,800 and 4,200 gpm. capacity, together with wash water pumps and other auxiliaries.

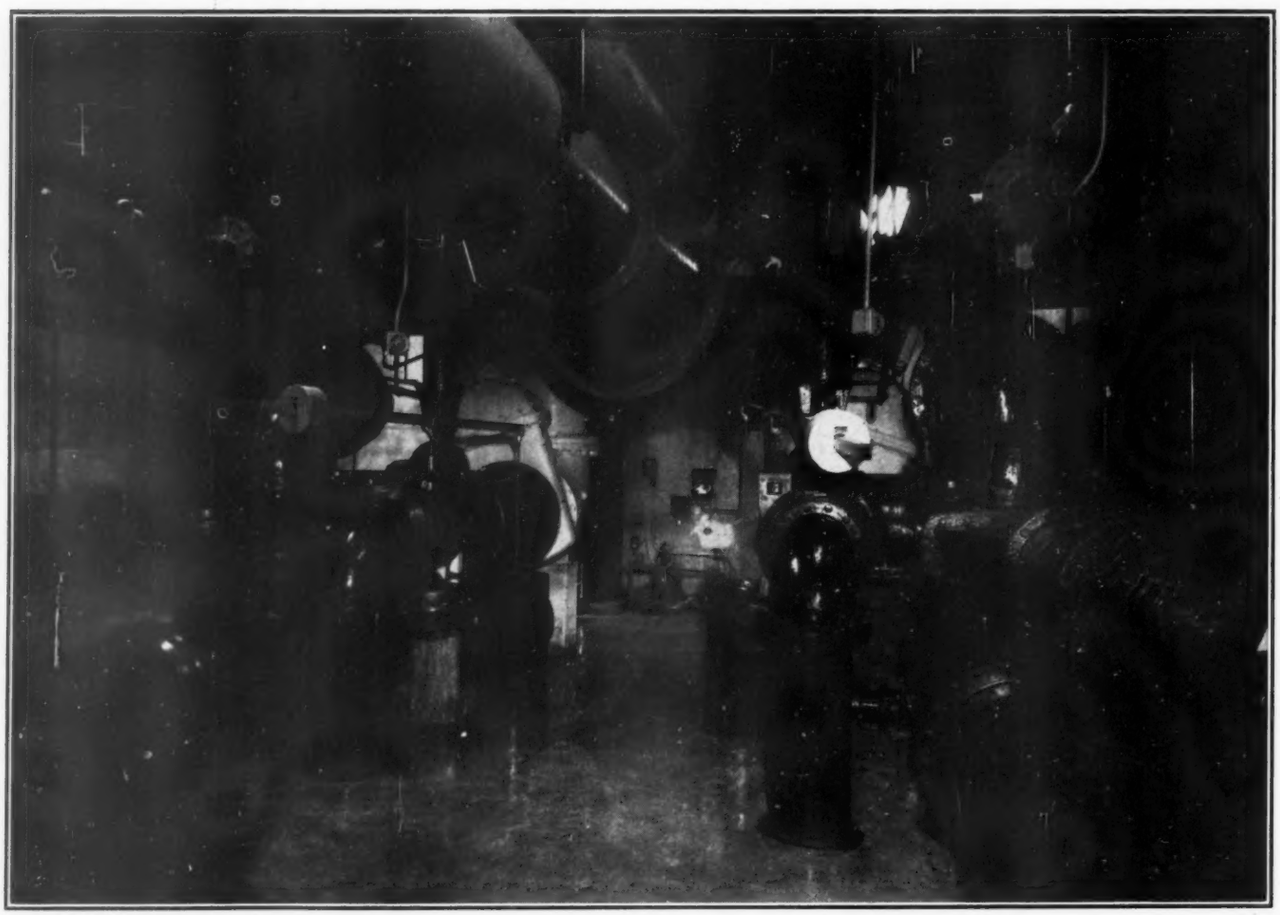
The plant was located to use the high land near the end of the reservoir dam as the site of the sedimentation basins and wash water tank and the low land below and adjacent to the spillway section of the dam as the location of a gravity aerator, the pump station and clear well. The filters are built between these high and low elements and the entire plant is arranged so that it occupies but two floors with clear well beneath. A roadway entering at the high level leads to the doorway of the chemical storage room, facilitating the handling of chemicals without the use of an elevator.

The raw water intake was contrived within the existing wasteway at the end of the spillway. The stop plank grooves ahead of the sluice gates were made to house a three-section bulkhead, one section having an opening 3 feet by 9 inches by 3 feet with coarse bar screens. By proper arrangement of the bulkhead sections water can be taken at approximately the third points on the 19 feet of depth of water at full pond. By constructing a vertical head wall for the intake pipe line at the downstream end of the wasteway walls, sufficient space was available between the sluice gates and this head wall to install a traveling mesh screen.

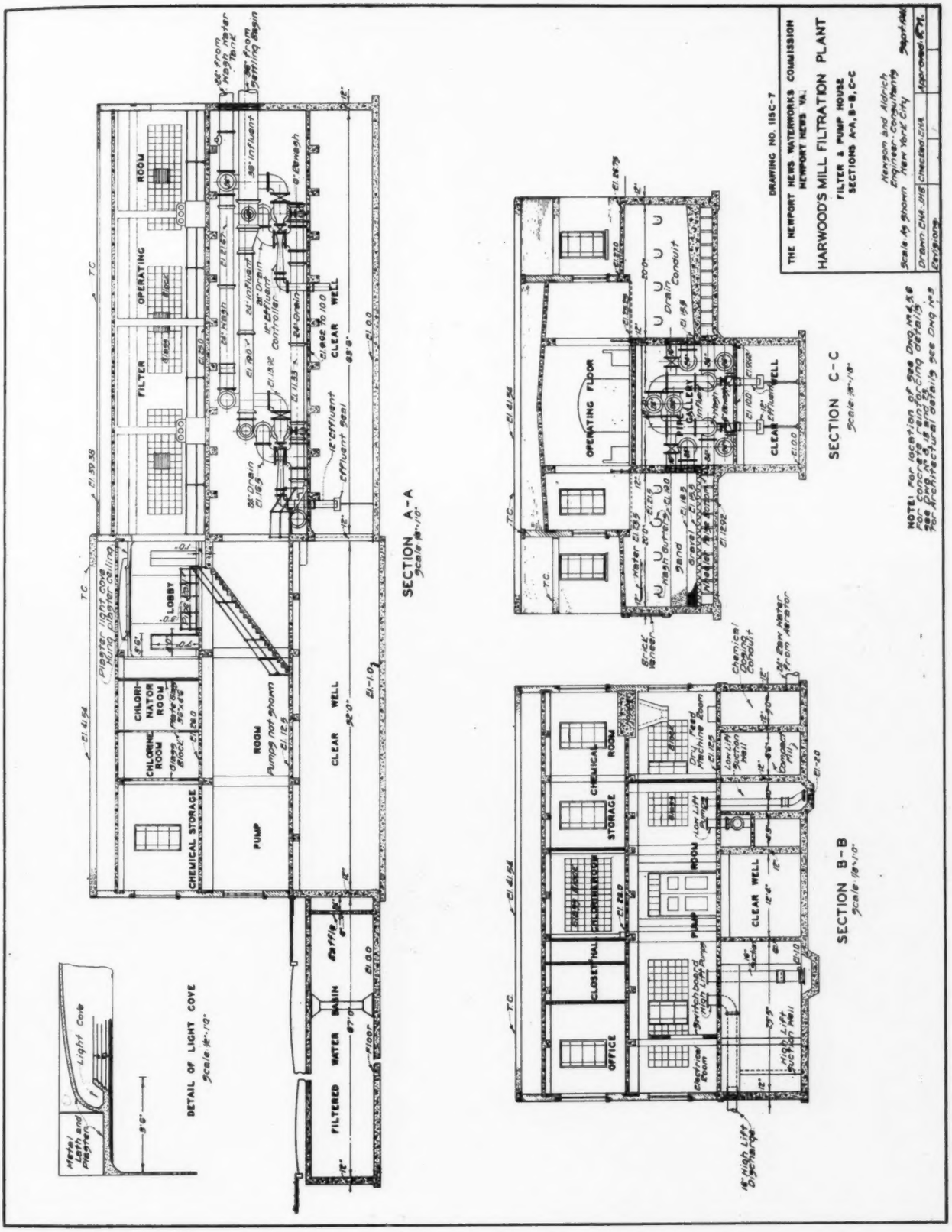
The Aerator

The top of the spillway is at elevation 20.0 and the water in the brook below the dam is substantially at tide water level. The top of the aerator is at elevation 13.0 and flow to it is controlled by a float valve with float located in the basin below the aerator at elevation 6.75. The aerator consists of two compartments with a single 20 inch riser pipe ending in a distributing pan. Each compartment consists of 4 layers of coke trays, five trays to each layer. If the reservoir level falls below that required to force sufficient water through the 24 inch raw water line to the top of the aerator, the latter can be by-passed.

From the aerator basin (or the by-pass) water flows through a 24 inch line to the suction well of the low lift pumps. This is constructed in two parts, the first being a chemical dosing conduit located below the dry feed machine room and adjacent to the lime solution tank.



The Pipe Gallery—Showing Valves and Controllers of Two of the Four Filters.



The Filter Plant and Pump Room

Chemicals are thus subjected to rapid mixing, resulting from going through the low lift pumps before the treated water passes through a 16 inch line to the flocculators.

Chemical Feed Facilities

In the dry feed machine room are provided three feeders and space for a fourth. With these, lime, alum and activated carbon are fed. The chemicals come from the floor above, through hoppers constructed as an integral part of the ceiling slab above the machines. While these chemicals are intended to be fed generally into the suction well of the low lift pumps, other points of entry are also provided.

Lime is also fed from the lime dilution tank to the clear well for pH correction. Alum can be supplied at the entrance to the aerator and to the middle point when the two settling basins are operating in series. Activated carbon can also be fed to the flocculated water conduit at the primary end of the settling basins and to the settled water line just inside the wall of the pipe gallery. Injectors are provided for use where required.

Flocculators

The flocculators or slow-mixing chambers, two in number, are simple cylinder concrete tanks, 27 feet in diameter and 16½ feet high, in which revolve two sets of paddles 21′ in length. These paddles are placed at 2½′ and 9½′ from the bottom. They can be operated at four speeds, 6-4-3-2 rpm, being driven through 300 to 1 speed reducers by 5 HP motors with four corresponding speeds. At a height of 15′ of water is located a circular weir 4′ in diameter, forming the entrance to a cylinder 3½′ deep surrounding the paddle shaft, to which is connected a 30″ discharge line leading to the settling basins. A connecting pipe allows the flocculators to be used in series as well as in parallel.

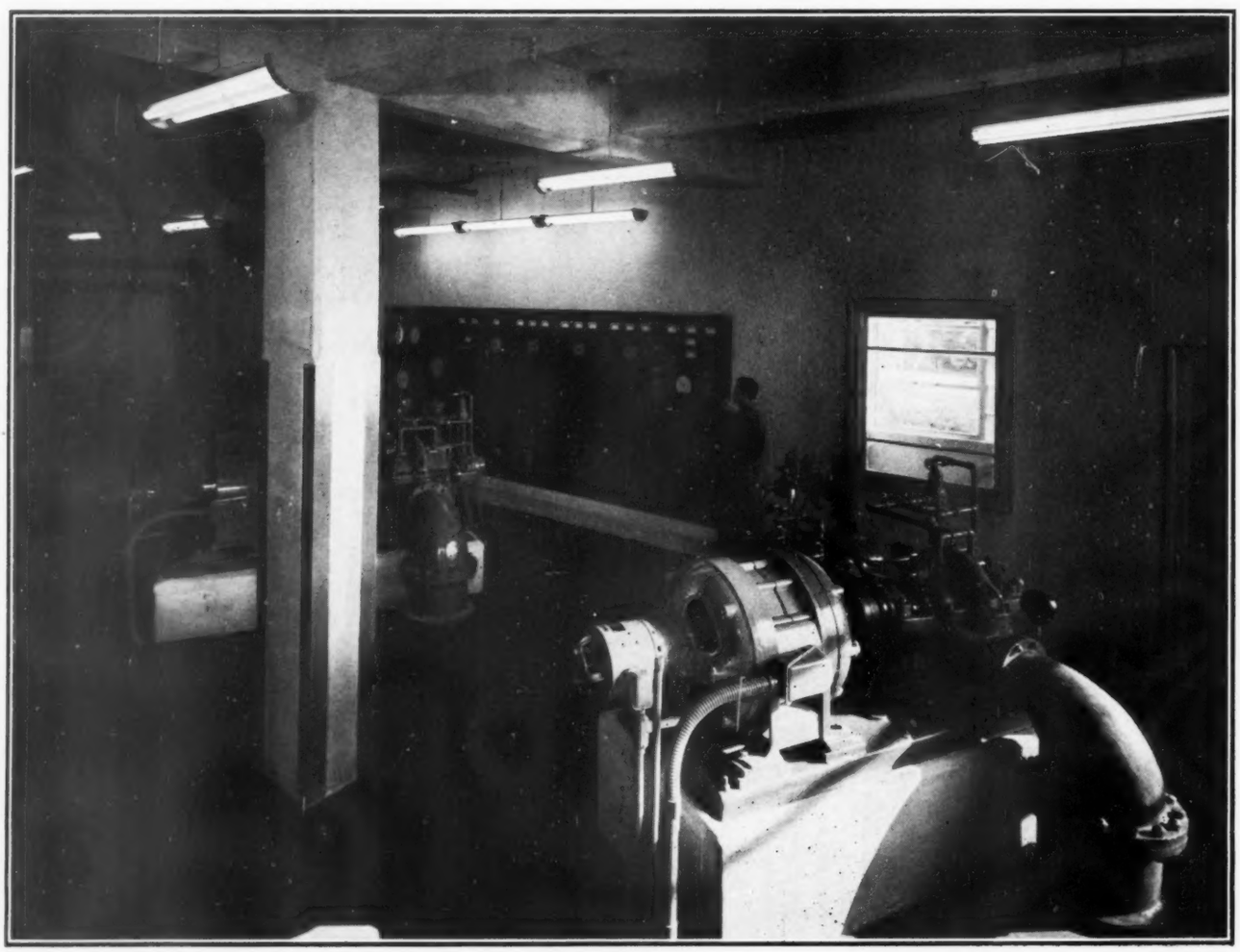
Clarification Basins

The settling basins when operating in parallel provide four hours retention at an output of 6.0 mgd. They are each 42′x113′ with a water depth of 15′. Between the basins and supported on the dividing wall is a 3′x4′ conduit, by use of which the two basins can be operated in series if desirable. The water to be treated is high in color and low in turbidity. The plant is producing an excellent floc and its settling is entirely satisfactory with the basins in parallel.

The settled water line leading to the filters is 36″ in diameter and enters the pipe gallery at the rear end of the filter and pump station building. Also coming into the pipe gallery from the same end is a 24″ wash water line from the 150,000 gallon reinforced concrete standpipe located on higher ground behind the filter plant.

Filter Washing Facilities

The water contained in the upper two-thirds of this standpipe is sufficient for two successive filter washes. The structure is 30′ high, 30′ in diameter and high water is 40 feet above the level of the wash water gutters. The standpipe was originally specified as steel provided with cathodic protection. Inability to procure the required plates with the priority rating available, and the necessity for saving steel lead to substitution of a reinforced



The Pump Room

concrete standpipe during the course of construction.

Wash water is pumped to the tank by duplicate 400 gpm. centrifugal pumps designed to operate economically within a range of from 30 to 60 feet with maximum efficiency at a 50-foot head. These pumps, driven by 7½ hp. motors, are located in a corner of the pump room and take their suction from the clear well beneath.

Wheeler Bottom Filters

The four 1.5 mgd. filters are of the double rectangular type with center gullet. They are rated on a basis of 2 gallons per square foot per minute. The underdrain system is of the Wheeler false bottom type. All pipe lines entering and leaving the filters are of cast iron and are located in a central pipe gallery having a pair of filters on each side.

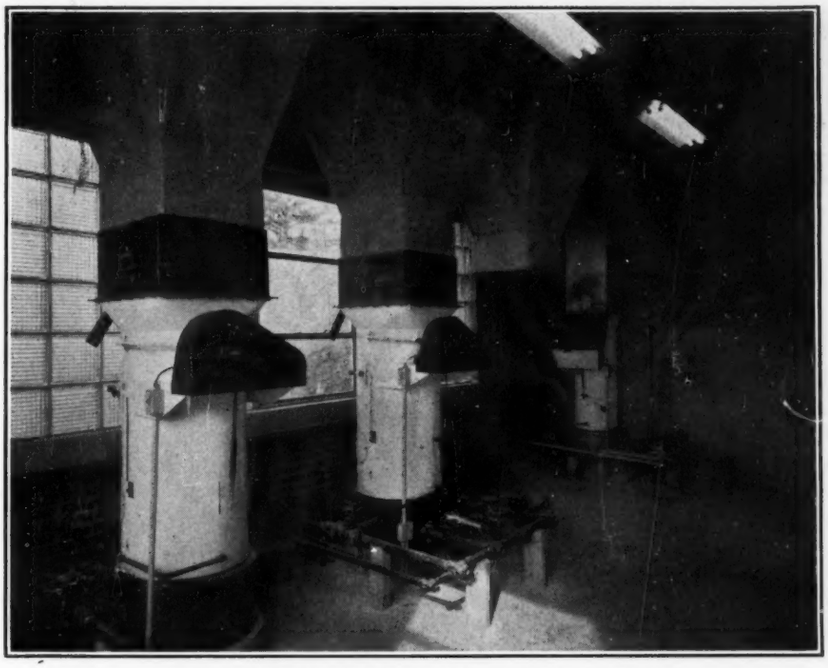
The filters, cast iron wash water gutters and drain lines are designed for a sand expansion of 50 per cent with provision for washing up to a rate of 42 inches per minute vertical rise if necessary to attain that percentage of expansion. The sand used in the filters has an effective size of between .40 mm. and .45 mm. and a uniformity coefficient not exceeding 1.6.

Hydraulic Valves Have Independent Water Supply

All valves are hydraulically operated, taking pressure from the discharge line from the high lift pumps. In order to assure their operation in case of accident to the transmission main going to the city, an independent source of water supply is provided by a motor-operated 10 gpm. pump and a compressor and pressure tank. When the pressure in the water supply lines within the building drops below 50 psi., the automatic control cuts in the auxiliary supply, closing a check valve in the high pressure water supply line at the entrance to the pipe gallery. When the city pressure is restored, the auxiliary supply cuts out at 75 psi. Control of the filters is thus assured even under emergency conditions.

Operating Tables

The filter operating tables are equipped with control levers to operate the influent, effluent, wash and waste valves. These levers have indicators which are electrically actuated, and by the use of individual lights show eight positions of the valves between full opening and full closing. The tables also are equipped for the control of surface wash if it is subsequently found desirable to install it. A sampler table is provided and connected to show the raw, treated, settled and filtered water.



Omega Chemical Feeders—Newport News, Va.

The operating floor of the filters ends at the middle of the building in a small balcony which is at the top of the main stairs from the pump room. This balcony is the only space in the nature of a lobby in the building. Off of this balcony are two entrances, one into the chemical storage room which occupies about half of the front of the second story, and the other into a small hallway. From this hallway are entrances into the laboratory, office, toilet and chlorine room.

Chlorination

In the latter are provided one 200-pound and one 100-pound manually controlled, solution feed, vacuum type chlorinators and a 40-pound manually controlled, direct feed ammoniator. Chlorine is fed from the larger machine to the 24-inch aerated water line and from the smaller machine to the clear well at a point below the forward end of the filters. Ammonia is fed to the filtered water after it has traversed the length of the clear well at the point of entry to the high lift suction well.

All Pipe Cement Lined

All water pipe lines in the plant are cement lined. This applies not only to the cast iron pipe and fittings in the filter gallery and around the grounds ranging from the 36-inch filtered water line to the 4-inch pressure water line, but also to the threaded steel lines from 3 inches down to ¾ inch in diameter within the building.

Pumping Facilities

The pump room on the first floor of the building is at approximately the level of the pipe gallery. The main entrance of the building opens directly into the pump room. Underlying the pipe gallery and center of the pump room is the clear well. Through control gates water passes through a narrow baffled passage to the filtered water basin, located under the driveway in front of the building. In this passageway, where the velocity is high, lime for pH control is applied. The filtered water basin is 68 ft. x 62 ft. with a depth of water of approximately 8 feet. The capacity of the filtered water storage, including the clear well and the high lift suction basin, is 450,000 gallons.

The three low lift pumps, operating against approximately 25 feet of head, are driven by one 25 HP., one 30 HP. and one 40 HP. induction motors. The three high lift pumps of 6.0, 4.0 and 3.0 mgd. capacity, operating against 80 to 90 psi., are direct connected, respectively, to a 300 HP., a 200 HP. and a 125 HP. synchronous motor. Both low and high lift pumps are equipped with water jet primers and, in addition, a wet vacuum pump is provided and piped to all units. The 6.0 mgd. and 4.0 mgd. pumps have guaranteed efficiencies of 87 per cent and the 3.0 mgd. pump of 84 per cent. The synchronous motors operating at unity

A View from the Chlorinator Room Into the Filter Room.

power factor have guaranteed efficiencies of from 93.6 per cent to 94.9 per cent.

These high lift pumps are equipped with automatic cone valves which have both rapid and slow rates of closing. This station is situated at the end of eight miles of 30-inch pipe, which divides into two 20-inch branches, which, together with 16-inch and 12-inch sub-branches and through connections to other transmission mains, lead to two elevated tanks in the distribution system. One tank is approximately 12½ miles from the station and the other is about 16 miles distant. The problem of surge and water hammer from quick shutoffs of the pumps has, therefore, been given considerable attention.

Surge Supression

In order to prevent surge from routine shutdowns of the plant, the cone valves are connected hydraulically and electrically so that the controls may be set to consume some three minutes in closing. The valves close slowly to a predetermined point, which is well toward complete closure. The resulting build-up of pressure on the pump side trips the power circuit. The pumps stop and instantly the remainder of the valve travel to complete closure takes place quickly.

The valves are also equipped to close quickly in an emergency, either through loss of power or by depressing the emergency stop button on the switchboard, in which case the loss of power condition is simulated. Under such a condition the valves close in less than half a minute. The actual closing of the valves is done hydraulically by water from either the pump side or the discharge main side of the valve. Under conditions of a break in the discharge line near the station and a required quick shutoff of the pumps, the cone valves might not get entirely closed before the pressure became too low to operate the hydraulic cylinders. To provide against such a contingency the auxiliary water supply provided to operate the hydraulic valves around the filters in case of emergency loss of pressure is connected through the priming piping to the hydraulic cylinders of the cone valves.

Under emergency conditions the pumps stop quickly with the customary wave of low pressure down the pipe line, followed by a surge when the high pressure wave returns. With the velocities and the length of line involved here, such a surge can be very destructive. The ordinary relief valve does not open until the surge returns and runs the pressure up to the valve setting. This pressure run-up goes considerably beyond the point of opening very quickly and can create a severe shock before any appreciable flow can start through the valve to relieve it.

At the Harwood's Mill plant, therefore, two 4-inch combination relief valves and surge suppressors have been installed. The surge suppressor opens the valve when the pressure drops to 60 psi. A pilot valve control prevents the valve from closing rapidly, holding it open until the pressure wave returns, at which time the valve is already discharging water and relief is given at once to the excess pressure. In spite of this relief, the pressure goes above normal. The valves are set to be opened by the pressure on the high side at 120 psi. This control keeps the valve open until the wave goes back and the low pressure side again takes control. Between these two controls the valve is kept open and discharging into the clear well for approximately three minutes and until the recurrent surges have died down. Further experiments may result in changing these settings somewhat.

The discharge from the relief valves into the clear well is below water so that if the first low pressure wave actually becomes negative, water rather than air will be taken into the line.

The Switchboard

The switchboard consists of eight panels with a total length of approximately 16 feet. Six panels are for electrical instruments and control and two for water gauges and station output meter. The incoming line panel carries, in addition to the power company meters, a station power factor meter, a voltmeter with transfer switch, an ammeter for each phase, and a control lever for the oil-circuit breaker. The latter is equipped with overload protection, controlled by inverse time limit attachments. Three panels are for controlling, respectively, the 300 HP., 200 HP. and 125 HP. synchronous motors driving the high lift pumps. These panels carry, in addition to controls for the individual oil-circuit breakers, power factor meters, watt-hour meters, AC and DC ammeters and start-stop push button stations for controlling the motor starters. These latter are in parallel with the starter controls on the cone valves.

The line voltage entering the station is 2,300, stepped down from 13,000 in a sub-station nearby on water works property. The high lift motors use the 2,300 volt current without transformation. Adjacent to the large motor panels is a transformed control panel on which is mounted the required ammeters and a circuit breaker control of the current going to the three 50 KVA. capacity, 2,300/4,160 Y to 120/240 volt transformers. These transformers supply the reduced voltage current for operating the low lift pumps and all auxiliary units in the station together with lighting.

The sixth panel contains an ammeter for each of the low lift pumps and nine start-stop push-button stations, each having a pilot light. Two of these stations have five buttons as they control the four-speed flocculator motors. The remaining seven stations control, in addition to the three low lift units, the two wash water pump motors, the priming pumps and the revolving screen motors. All of the small motors have start-stop stations at the units as well.

All low voltage starters are mounted together in a special distribution panel located in the transformer room rather than back of the board adjacent to 2,300 volt bus and wiring.

The seventh panel has mounted on it the Venturi meter indicator-recorder-totalizer in a rectangular case matching the balance of the board instruments. This instrument is actuated by a 24x11.6 inch tube. Also on this panel is space for a telemeter recording gauge if it is subsequently found necessary to have in the station a continuous record of the level in the controlling elevated tank in the distribution system.

The eighth panel carries three water level indicating gauges and a recording discharge line pressure gauge. The water level gauges show the height of the water in the wash water tank, the settling basins and the clear well. The first two are electrically actuated by transmitters in the pipe gallery. The clear well gauge is operated by a bulb located beneath the electrical room on the floor of the high lift suction well.

Gauges and Meters

The wash water rate gauge is a 17-inch face illuminated gauge, mounted on the wall at the end of the filter operating floor. A similar sized water level gauge is also mounted there which is in parallel with the wash water level gauge on the switchboard. The wash water rate gauge is actuated by a 24x16.8-inch Venturi tube in the wash water line just inside the pipe gallery wall. Both the wash water and main line Venturi tubes are unique in that the upstream or reducing sections are of cast iron, lined with cement. The cement lining matches flush with the inner surface of the bronze throat.

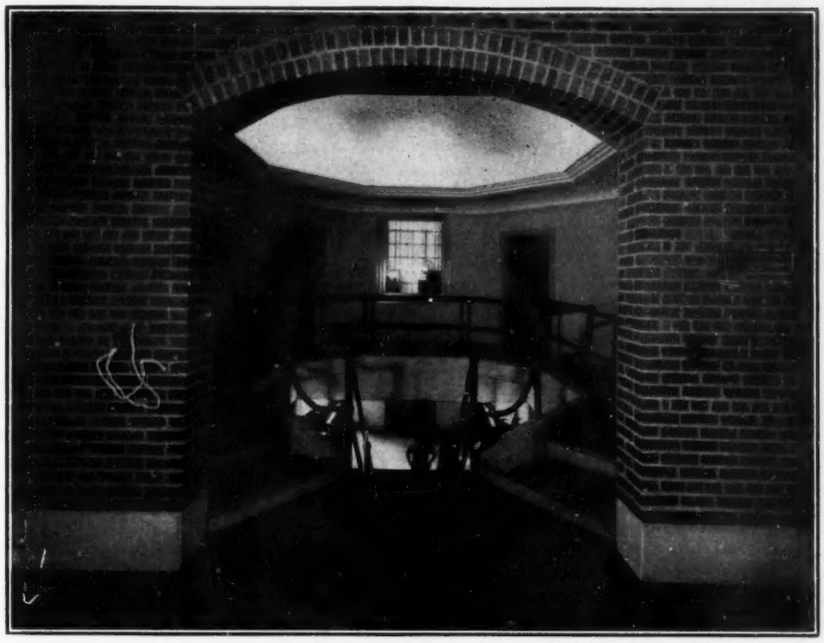
The amount of wash water pumped and the station use of water is measured and recorded by 6-inch impeller meters of the Sparling type, the station use meter being a 6x2-inch compound.

The plant is heated by a combined system of hot air ducts and registers in the offices and laboratory and hot water lines to unit heaters throughout the larger rooms of the plant. See Filter Operating Floor cut. Oil is used as fuel.

Lighting is generally fluorescent except for external and filter bed vapor-proof lights.

Attached to the plant and built as part of the general contract are three operators' residences of the two-bedroom type, of approximately 11,000 cubic feet volume each.

The total floor area occupied by this 6.0 mgi. filter plant and pump station, including in addition to the pump room and filter gallery, the dry feed machine and chlorination rooms, the filter operating floor, the chemical storage, an office on each floor, and a laboratory, is 4,300 square feet.



A View Across the Lobby from the Filter Room Toward the Chlorinator Room Laboratory and Office

Costs

The total cost of the plant as herein described is $422,630. This cost may be broken down into the following sub-divisions:

Excavation and piling	$ 52,310
Concrete masonry	156,720
Superstructure and appurtenances	42,100
Filter equipment	33,493
Piping and valves	58,462
Pumping equipment	42,231
Miscellaneous equipment	14,703
Operators' residences	12,908
Miscellaneous	9,703
	$422,630

The cost of the transmission mains was $606,982. The pipe was furnished by Lynchburg Foundry.

A comparison of the bid prices, estimated cost, and actual cost on the job is of interest:

Low bidder	$ 989,029
Second bidder	1,030,770
Third bidder	1,040,475
Engineer's estimate	1,060,420*
Actual cost	1,029,612*
Fourth bidder	1,079,992
Fifth bidder	1,092,035
High bidder	1,211,305

*It will be noted that the actual cost under-ran the engineer's estimate by 2.8% and over-ran the contract award price based on estimated quantities by 4.1%.

The 17 miles of 30 to 12-inch cast iron lines leading from the plant to the city are cement lined and have a bitumastic seal coat inside the lining. The pipe was painted on the outside prior to lining, but the inside was left uncoated before cement lining.

The 20, 16 and 12-inch pipe was made according to Federal Specifications WW-P-421 for Class 150 Pipe.

The 30-inch pipe was made to specifications, using the method of design in Part I of the Manual for the Computation of Strength and Thickness of Cast Iron Pipe, A.S.A.-A21.1-1939. It was designed for a working pressure of 210 feet; field condition, B; controlling condition, truck load; bursting strength, 21,000 psi.; crushing strength, 45,000 psi.; foundry thickness tolerance, .08 inch. If the latter was limited to .06 inch the bursting and crushing strengths were reduced respectively to 18,000 psi. and 40,000 psi. The thickness, including tolerances, was limited to not less than .72 inch.

Acceptance tests of this pipe included ring tests on one pipe out of each 50 lengths cast; Talbot strip tests from one pipe out of each 8-hour heat or from three out of each 50 lengths cast, whichever was the more frequent, and a test to destruction of one pipe per week or one out of each 300 lengths cast, whichever was the more frequent.

Contractor and Sub-Contractors

The design of the Harwood's Mill Filter Plant was primarily the work of E. H. Aldrich, who also had charge of the supervision of construction. The general contractor was Bass Engineering & Construc-

tion Co., Detroit, Mich. The subcontractor laying the transmission mains was A. Stanley Mundy Co. of Woodbridge, N. J. There follows a list of the principal items of equipment in the plant and the firms which furnished them:

Filter equipment—Roberts.
Pumping equipment and switch gear—Allis-Chalmers.
Controllers and filter gauges—Simplex.
Venturis—Simplex.
Cast iron pipe and specials—Lynchburg foundry.
Gate valves—Darling.
Sluice gates—Mueller.
Relief valves and cone valves—S. Morgan Smith.
Float valve—Golden-Anderson.
Chlorinators and ammoniators—Wallace & Tiernan.
Dry feed machines—Omega.
Scales—Fairbanks-Morse.
Level and pressure gauges—Bristol.
Mechanical screen—Link Belt.
Impeller meters—Sparling.
Vacuum pumps—Nash.
Heating and conditioning equipment—Kewanee and American Blower.
Laboratory equipment—Phipps & Bird.
Laboratory furniture—Hamilton.

F. Herbert Snow, 1865-1942

F. HERBERT SNOW of Harrisburg, Pa., passed away in his home on October 29, 1942, marking the end of a fruitful life of a capable engineer who held the high esteem of many. During the last ten years of his life he was best known as Secretary of the Pennsylvania Water Works Association.

Mr. Snow was born in Providence, R. I., November 2, 1865. At twenty he had completed his courses in the Mass. Institute of Technology. He entered municipal engineering as a profession the same year (1885) with the City of Brockton, Mass. He became City Engineer of Brockton five years thereafter—1890. Eight years of then spectacular pioneering in municipal engineering then followed at Brockton. Amongst the achievements was found the earliest removal of railroad grade crossings known. Then was constructed a complete sewerage system, including one of the very earliest sewage treatment plants in America. The Brockton plant, because of its laboratory control and published reports, attracted wide attention. It proved a success, but young City Engineer Snow (then less than 25 years old) was accused by older Brockton citizens of gambling with city funds.

Before he left Brockton in 1898 to take on a young man named Frank A. Barbour and set up the consulting firm of Snow and Barbour, Mr. Snow had prepared plans for a new source of water supply for Brockton, which was installed by his successor. One must admit that in his first eight years of professional engineering this was a pretty fair start for a young man who had vision and wasn't afraid to try new things. If he did "gamble" with city funds he won, and Brockton has since paid his pioneering high tribute. On that occasion Mr. Snow said, "The city was young, and so was I. We were not afraid to venture beyond the beaten path."

The expanding consulting work of Snow and Barbour took Mr. Snow into Pennsylvania, amongst other states, and here recognition of his work *and vision* brought to him in 1905 the position of Chief Engineer in the Pennsylvania State Dept. of Health, that year organized by Dr. Samuel G. Dixon. During his nine year tenure as Chief Engineer of the Department his vigor and engineering prowess left many monuments to denote a successful enterprise and another pioneering achievement of note in Mr. Snow's career.

In recognition of his services in connection with the housing and care of Civil War veterans attending the 50th Anniversary Reunion at Gettysburg, Pa., in 1913, Mr. Snow was awarded a special medal by the Federal Reunion Commission. It was at this time that he came by the honorary title of "Doctor," by which he has been known ever since, principally because it seemed to fit an individual of so much vision and developmental ability and pioneering spirit. It might be termed an Honorary Degree by Acclaim.

Upon the creation of the Pennsylvania Public Service Commission in 1914, Dr. Snow was chosen as its Chief Engineer—another pioneering enterprise in which Dr. Snow's ability and influence contributed much to the successful endeavors of this early commission charged with public utility regulation.

During World War I Dr. Snow served as Executive Secretary of the War Board in the Pittsburgh District, and returned to the Commission, which he continued to serve as Chief Engineer until retiring in 1932. It was then that he accepted the Secretaryship of the Pennsylvania Water Works Association, an organization of high value composed exclusively of company or individually owned water works in Pennsylvania. In recognition of his many pioneering achievements and his services to the Association, he was made Honorary Member in 1940.

Dr. Snow had been active and influential in many engineering associations. He founded the Engineer's Society of Pennsylvania, which he served as president, and was a member of the American Society of Civil Engineers and the American Water Works Association amongst others. His services as advisor and consultant continued in demand up to his death, at which time he was serving the District of Columbia and the City of Harrisburg, Pa., on matters pertaining to water supply.

An Episcopalian, Dr. Snow was a Mason, in both the York and Scottish Rites.

Do You Have This Packing Trouble? If So, Turn to One of the Metallic Packings*

Every once in a while I hear of packing troubles caused by expansion of the packing. When the packing gets hot it expands and the expansion makes the packing too tight, thereby interfering with shaft rotation, movement of piston rods, valve stems, or whatever it is that is packed.

The best remedy possible for a condition of this kind is to use a packing which neither expands nor contracts on heating or cooling. I know there is at least one such packing on the market, this one being a so-called "metallic packing." Its success comes from the use of metal possessing the desirable property of expanding upon cooling and contracting upon heating. It is therefore an ideal substance for packing because, in reality, in conjunction with the other materials in the packing, we are given a packing which in total volume neither increases nor decreases regardless of the temperature. This metal withstands temperatures up to 1200 deg. F. It also resists corrosion from acids, alkalies and electrolysis.

I recall that years ago it was thought that packings could not be improved. We thought we had the "last word" in packings. But, surprising as it may seem, improvements in packings are being made right along and I dare say they will continue to be made for many years to come.

*A suggestion from W. F. Schaphorst, M.E., Newark, N. J.

THE MAINTENANCE OF ELEVATED TANKS

By JOHN M. PERRYMAN
Engineer,
R. D. Cole Manufacturing Co.,
Newnan, Ga.

TANKS and towers are an important part of most water supply and fire protection systems, and should receive the same care and attention as other important parts of such systems.

It is generally known that corrosion of iron and steel is a silent enemy, working during both war and peace through all the years. The conversion of steel into iron oxide or rust is Nature's course in returning iron or steel into its original state.

The Author

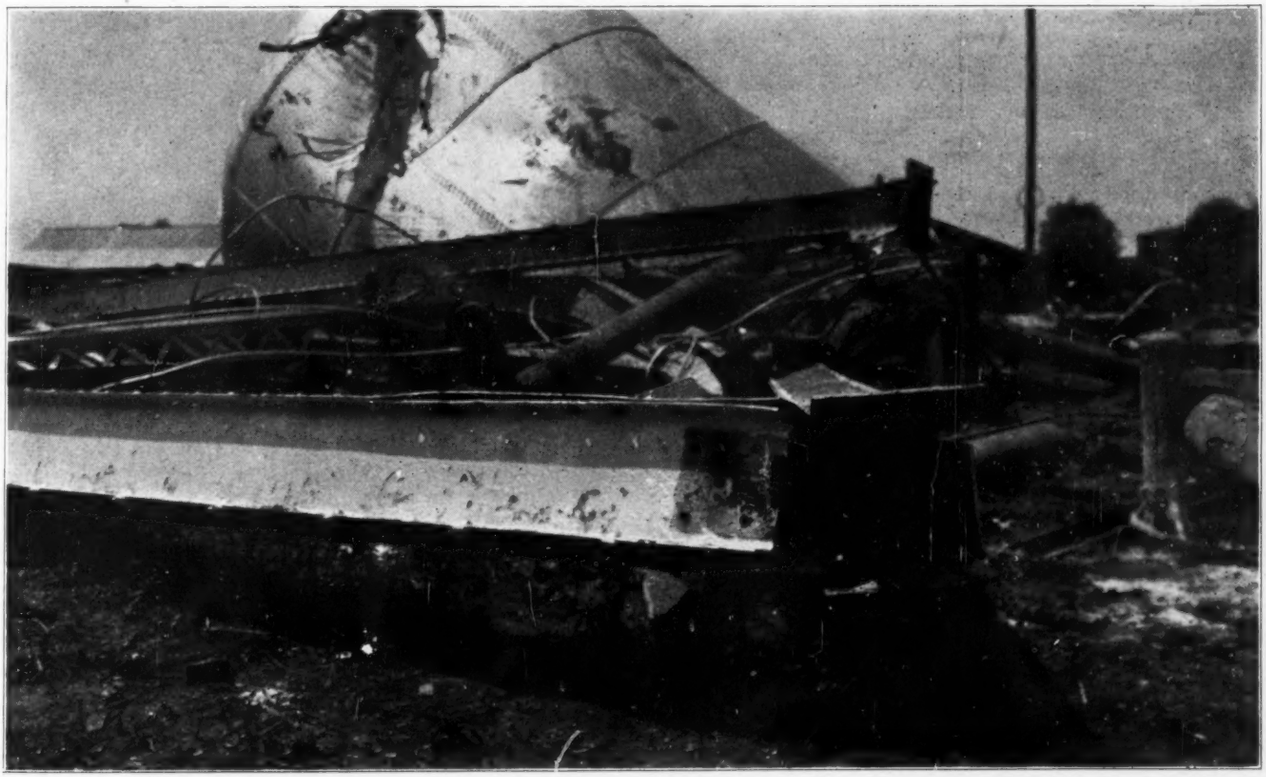
Air and water coming into contact with steel starts this cycle of returning iron and steel to rust. Rust occupies more space and also weighs more than the steel destroyed, for it consists of hydrous iron-oxide which is 54% iron, 20% oxygen and 26% water. Due to capillary action water will climb a rusty steel tank shell or column, regardless of its height. Corrosion of steel tanks can be caused and accelerated by the presence of acid fumes in the air, and particularly are tanks in large industrial areas thus affected. Also tanks located in areas of high humidity and along coastal waters, where high salt bearing vapors are present, are subject to accelerated rusting.

Surface Preparation

Tanks should be protected at all times from the elements that cause rust, using a paint that will protect the surface and present a favorable appearance. Steel can be protected at a reasonable cost by the use of rust inhibitive steel coatings. In preparing the surface the use of expensive sand-blasting is not necessary, nor chipping to the bare metal The use of hand or power driven wire brushes is really all the preparation that is essential. The simple method of removing loose paint, scale and dirt by hand brushing, then applying a rust-inhibitor to seal the steel from the atmosphere will protect and prolong the life of your structure.

Loadings on Tower Members

As an example of the heavy loadings, on the tank tower structure, I might mention the 2,000,000 gallon tank in Charleston, S. C. The water and metal loading exceeds the weight of 6000 Ford cars, and the 100,000 gallon tank at Mt. Pleasant, S. C. amounts to 325 Ford cars. You can see from this that the tower load involved in overhead tanks is



It Can Happen!

This WAS a nice tank but it fell because of a weakened understruct ure. Saying it another way—GOOD TANK MAINTENANCE PAYS!

This Tank Has a Nice New Coat of Paint, But—

an inspection by a qualified man would have avoided a dangerous condition. In very poor condition, the base of this recently painted tank was not given needed attention. It was not cleaned properly before painting and the base plate should have been grouted to shed water, prevent corrosion and frost spalling.

appreciable, and must be dealt with according to a scientific business like procedure.

The Inspection

To assure long life and prevent, as near as practicable, the formation of rust, and in addition provide a safe structure, the tank should be drained completely, allowed to dry, and inspected by a competent inspector at intervals not to exceed five years.

These inspections should be made by no other than a skilled man who is thoroughly competent to detect weaknesses and pass upon their importance. This is not a matter which can be left to transient steeplejacks or traveling inspectors of unknown ability and integrity — the man should be a structural engineer. In locations where the water is highly aerated or contains particularly corrosive elements, the examination should be made more frequently than once in five years.

When an inspection is to be made, the fire chief and others dependent upon the water supply should be notified in order that they may not be dependent upon the tank for extra head and volume during the planned outage.

What to Look For

The inspection should consist of: first, an examination of all ladders for safety; especially examine for missing connecting bolts, conditions of lugs and rungs, etc. The revolving ladder on the roof should be inspected for a poor connection at the finial, also the ladders on the inside of the tank and rise should come in for thorough examination. Check condition of the roof and spider, and be sure that it will prevent the entrance of birds and other harmful matter, and that it will safely withstand sudden high winds. Examine the tank proper for loose scale and leaky rivets and seams.

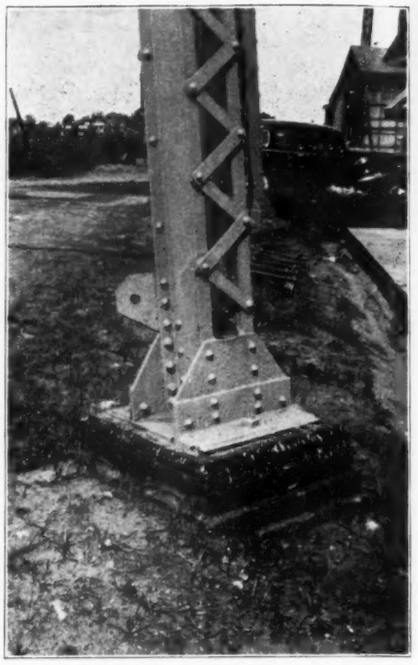
The balcony floor is designed to resist the thrust of the columns and should be perforated at proper places so that water will not stand on the floor. Examine the hand rail for safety, also all rods, turnbuckles, clevises and pins.

Repairs and Replacements

Before repainting you should be certain that all badly corroded parts have been replaced or properly repaired. Look *under* the clevis pins and rod loops on your tank. The top side may be in excellent condition, but *the underside and partially hidden section may be found to be in a dangerous condition.* Examine the back surfaces of lattice bars, anchor bolts, the inside of boxed channel columns, pockets where batten plate connections and column bases form pockets for collecting trash and water without proper drainage. These enclosures may be cleaned and painted, then filled with concrete to a proper level at the top and shaped to shed water. Base plates should be grouted with sand and road oil mixed, or with asphalt.

Where angles or other structural sections are separated by narrow spaces, rust can usually be removed by using narrow, bent scrapers, and the sides of the angles facing the narrow space may be painted with a spray gun. The present day manufacturer of elevated tanks endeavors to offer a tank design using open sections that can be readily inspected, cleaned and maintained.

If structural members of details affecting the strength of the tower are found to be in a condition such that they must be replaced, they should be renewed by a *recognized* tank designer, fabricator and *skilled* erectors. Diagonal wind rods should not be removed for cleaning and repairing, except when the tank is empty and on a calm day, and then only when adequate provision has been made by means of struts and guy wires to prevent a possible collapse of the structure.



Another Bad Base Condition

The base structure has been cleaned and painted but the brick foundation is badly in need of repairs. This picture also reveals the hazardous practice of removing the lower tower rods.

The bases and base plates must be examined, and if the base is so built that it holds water (see illustration), drill a 1½-inch hole through the channel boxed section to permit drainage. Trash should be removed at regular intervals. The base plates should be grouted with a mixture of sand and asphalt so water cannot run under the plates. The grout should taper off from top edge of plate to concrete pier.

There are a number of elevated tanks built with auxiliary tanks of smaller capacity suspended underneath, also flat bottom tanks built on supporting grillage. When these tanks are inspected, look for badly corroded suspension rods and connections to the tank. They quite often are found in a dangerous condition. The steel grillage on flat bottom tanks is subject to heavy corrosion and only on careful examination will you find those connections that have become unsafe. There have recently been some tanks found in dangerous condition that were originally built without balconies and not sufficient reinforcing at the column connections. The shell plates have actually broken, due to over-stressing and fatigue of the metal.

Concerning Rivets and Seams

Much has been said about leaking rivets and seams. The facts are that in most cases the importance of this is exaggerated and sometimes used by unscrupulous repairmen as an entry and excuse for expensive repair work.

Loose rivets can be caulked just as effectively as can leaky seams. Don't let anyone tell you that because the head of a rivet is badly pitted that it must be removed and a new one driven. Remember that a rivet head is to hold the plates firmly together, and other than holding a small tension between the plates, a corroded head does not seriously impair the strength of your structure. *It is the shank of the rivet that really does the job.* Furthermore, when a rivet is knocked out, you loosen at least eight additional adjoining rivets, thus a larger repair job has been created. Be careful!

Cleaning

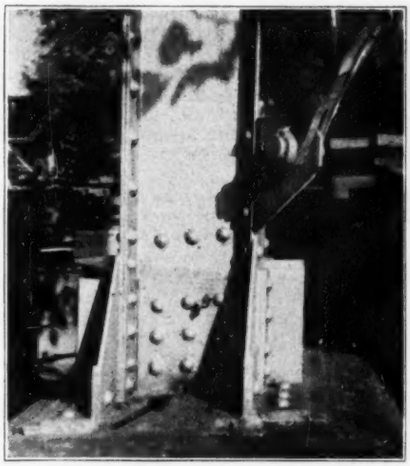
After all of the above procedure has been carried out, the tank should be thoroughly cleaned both inside and outside, as well as the tower and other parts of the structure. Paint or mill scale which adheres firmly to uncorroded steel should *not* be removed, but these surfaces should be cleaned to remove all loose dirt or sediment. Where extensive pitting of the steel beneath several coats of paint is encountered, this portion should be vigorously wire brushed with a power tool to prepare properly for the new coat of paint.

If the tank has a large steel riser (36-inch diameter or larger), all sediment can be removed from the base by the means of the washout valve in the base of such risers. However, if the tank has a small cast iron or steel riser of from, say, 8 to 12 inches, it will be necessary to bail the sediment from the bottom of the tank, since these tanks are in general without washout valves.

Remember to repack the expansion joint and replace all brittle and leaking gaskets at manholes. Frostproof casings should be repaired or replaced; or, even better, remove both pipe and casing and have a 36-inch steel riser installed in its place if the size of the installation will justify it.

Painting

Best results from painting are obtained when the outside temperature is above 50 F. and the temperature of the paint and surface to be painted are the same. Painters should be cautioned not to allow trash, paint



An Important Hole to Keep Open

The arrow points to the deep hole in the boxed-in column section to drain water from this type of base.

or other material to drop down the riser while they are cleaning or painting. A sheet of heavy paper may be tied over the small riser, or a deck may be built across a large riser pipe.

Interior

During the summer it is best to paint tank interiors at night in order to avoid uncomfortably high temperatures. Paint dries more quickly on the inside if the manhole cover is removed and the roof hatch is left open. Forced air circulation has a definite advantage in expediting the painting job, and it should be remembered that forced circulation adds greatly to protection of the painters and accelerates drying.

It is recommended that the inside of the tank, riser and underside of the roof be painted with two complete coats of red lead and a final coat of black interior tank finish. This finishing coat should be of the type that does not impart any taste, odor, or discoloration to the water.

The coat of black interior tank finish is actually to protect the red lead, and, of course, the red lead is to protect the steel.

Exterior

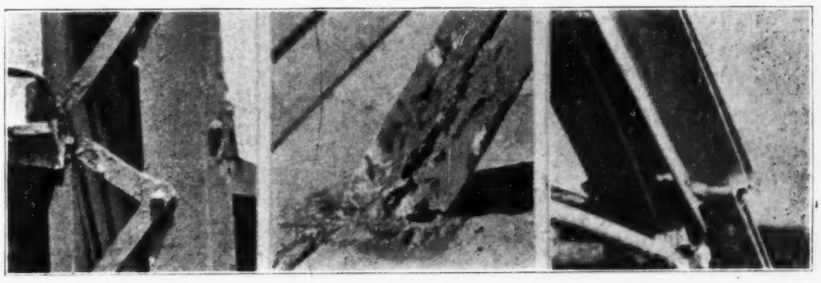
Paints tend to loose their imperviousness when submerged in water for long periods, such as on the inside of tanks. It is suggested that 10 per cent by weight of litharge be added to resist the softening action and hasten the drying. The litharge may be mixed in a small amount of linseed oil and then added to the red lead as required.

The outside should be painted with a coat of either red lead or gray lead, followed by two coats of aluminum. It is also suggested that you paint all abraised surfaces with two touch-up coats prior to the finish painting with aluminum.

For best results, the final coat inside the tank should be allowed to dry *at least one week* before admitting water.

Safety and Cleanliness

Paint thinned with naphtha, benzol, toluol or other liquids which give off toxic vapors are hazardous to life when used in confined spaces such as inside of a tank. They should be used only by experienced painters who are thoroughly familiar with their proper applications and the hazards involved. Forced air circulation inside the tank and gas masks are essential where such dangerous materials are employed.



Some Bad Order Specimens

(Left) Lattice bars completely eaten away where building roof contacts the tower leg. (Center) Another specimen of badly corroded tower leg.

(Right) This obsolete style of tower leg has all but failed. It buckled under the full load weight.

After painting, particular care should be taken to make sure that all planks, scaffolding, rope, paint cans, brushes, and other material are removed from inside the tank and riser. This having been done, you should refill the tank, sterilize it in accordance with the Board of Health requirements, and restore service as soon as possible, considering good workmanship and proper drying as the first essentials.

Foundations should be examined, and if showing signs of deteriora-

tion should be carefully pointed up with a cement mix consisting of one part cement and one part of sand. There have been a number of foundation piers built of brick or stone. These should receive extra attention.

A typical specification for tank painting follows, and we believe that it will eliminate any possibility of the tank owner suffering from some unscrupulous contractor, holding him responsible for charges other than cleaning and painting, unless such extras are authorized in writing. Your attention is further directed to the practice made by most tank fabricators and erectors of making tank inspections at a nominal charge and giving a written report of work that, in their opinion, is actually necessary.

REPAINTING ELEVATED TANKS

(A Pattern for Specifications)

Bids are to be received for the furnishing of the necessary labor, tools, equipment and materials to clean and paint Elevated Steel Water Tank and on a steel tower elevating the bottom Steel Tower of ——— gallons capacity —— ft. —— in. above top of foundations, and/or Flat Bottom Steel Water Reservoir of ——— diameter x ——— height.

General: The inside of the tank proper and underside of roof is to be carefully examined and all loose paint, scale, rust and blisters are to be removed with scrapers and power wire brushes and the surfaces thoroughly dried. Paint or mill scale which adheres firmly to uncorroded steel need not be removed, but the surface should be cleaned to remove sediment and dirt. If there is extensive pitting of the steel, this is to be brought to the attention of the inspector for whom the work is being done.

The spider rods, inside ladder, or any other inside structural details, such as the inside of the large steel riser pipe, is to be thoroughly cleaned as previously mentioned before any paint is applied.

All dirt and sediment collecting at the base of the riser is to be removed.

Any brittle or leaking gaskets at the manhole, washout valve or other openings are to be replaced with new gaskets of equal or better materials.

The inside of the tank and large steel riser after being prepared as heretofore mentioned and approved by the inspector, are to be given one coat of red lead paint with 10 per cent by weight litharge added to offer resistance to softening action of the water and dry more quickly. After this red lead coat has become thoroughly dry, a coat of black interior tank finish paint is to be applied on the inside for the finish coat.

The outside of the tank is to be examined and cleaned as indicated for the inside, with especial attention being given to those parts of the tank structure which are difficult to clean, such as around the clevice pins and end of diagonal wind rods, anchor bolts or back surfaces of lattice bars or columns, inside channel columns near foundations, inside surface of members composed of angles which are separated by thin lattice bars, washers or short pipe.

If members or details effecting the strength of the structure are found seriously corroded, this should be brought to the attention of the inspector. Diagonal wind rods or other members should not be removed for cleaning, unless the tank is empty and adequate provision is made to prevent the structure from collapsing.

After the outside has been thoroughly cleaned, a touch-up coat of red lead is to be applied to all surfaces where the paint has been removed, and then the entire outside of the tank and tower is to be given two coats of aluminum paint of color selected by the purchaser and of a kind made purposely for application to outside of steel water tanks.

The contractor for this work is not to apply any paint, unless the outside temperature is above 50 degrees, and paint and surface of the steel should be approximately the same temperature.

Provision is to be made for the safety of the men, providing proper ventilation for working on the inside, and comply fully with all local and state laws; Workmen's Compensation, Public Liability and Property Damage Insurance are to be carried with $10,000.00 and $25,000.00 limits.

Certified copies of policies in force to be attached to contract.

The contractor is to employ only skilled elevated tank painters, and no other work except the above cleaning and painting is to be done, except with written approval.

Upon completion of the painting, the contractor is to remove or dispose of all rubbish or other unsightly material caused by their operation and leave the premises in as good condition as it was found.

Terms of payment: Net cash on completion and acceptance of work.

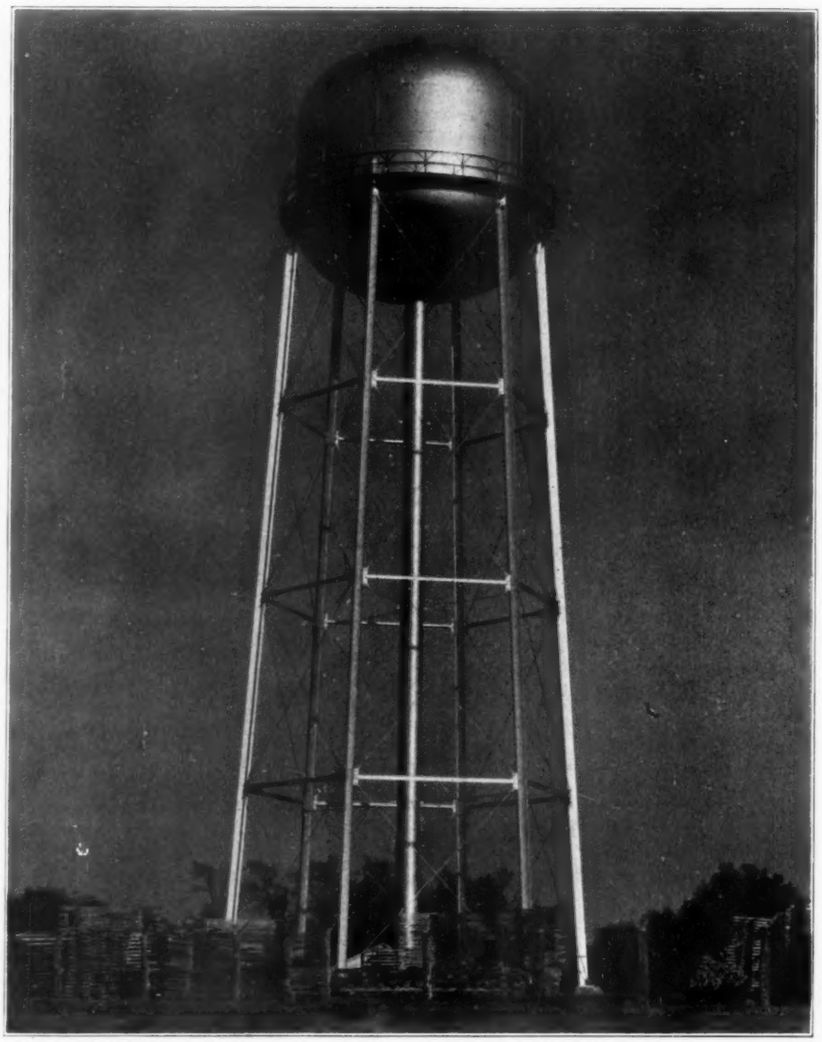
Additional Comments

Tanks with small cast iron risers and wooden frost casings should be examined and expansion joints repacked.

If hot water or steam pipes are in poor condition, they should be replaced.

Consult your insurance company and advise them when the tank will be out of service and length of time out of service.

If the tank is a municipal water supply unit, notify the local fire authorities when the tank will be out of service, so they will not be dependent on this volume of water for fire protection.



An Example of Modern Design in Steel Tanks

The cover is of the water storage type. There is no roof projection to catch high winds and possibly loosen the roof or the entire tank. Simple welded bases and elimination of the lattice bars and boxed-in columns make for easier and more economical maintenance.

WATER WORKS & SEWERAGE

Do These Two Utilities Belong Under Single Management?

By THOS. L. AMISS
Superintendent-Engineer
DEPARTMENT OF WATER AND SEWERAGE
SHREVEPORT, LOUISIANA

IN RESPONSE to a request from the Editor of WATER WORKS AND SEWERAGE, I shall attempt to answer the question, "Does water supply and sewerage properly belong under one management?" This question was, I believe, put to me because of a long experience in the joint management of a water and sewerage system first under private ownership and since under municipal ownership. Also probably because the editor has heard me state several of the reasons I have for believing that other than joint operation of these interlocking utilities results in much duplication of personnel, equipment and material and a waste of public monies.

In an effort to substantiate my claim that water supply and sewerage can be more satisfactorily and economically operated as interlocking utilities under single management, rather than as separate utilities, it is felt that by placing before you the setup of the Department of Water and Sewerage of the City of Shreveport, La., an actual example of joint operation for 56 years, I can better supply information to justify this claim.

Fifty-six years ago, on the 9th day of July, 1886, the City Council of Shreveport passed and adopted an ordinance entitled "An ordinance providing for the construction, maintenance and operation of a system of water works and a system of sanitary and domestic sewerage in the City of Shreveport" contracting with Samuel R. Bullock & Co. of New York for the completion of this project and their subsequent operation. These utilities were operated jointly under the former Shreveport Water Works Co., a private corporation, until January 1, 1917, and since by the City of Shreveport under the Department of Water and Sewerage as a municipal unit.

The combined operation of the water works system and the sanitary sewer system in this case has been critically tested, as you will note from the above: 31 years under private ownership and 25 years under municipal ownership, or over a half century under the two types of operation. This example is, to my thinking, a concrete case definitely presenting the worth of combined operation. Not even in the 25 years of municipal ownership and operation has there ever been any valid argument for divorcing the two operations.

The Author

A 41-Year Observation

Of the 56 years' operation, the writer has had 41 years direct association with the operation of the two systems, the first 16 years of which was under private ownership. My direct connection for this long period of time, my study of its operation from every angle, my observation of the effects of the operation as a single unit, places me in a position to present a few facts pertinent to the question.

Because of my first hand knowledge of this type operation and general knowledge of other most common types, I am heartily in accord with the joint or combined operation of the two most important public utilities—good water and sanitation being the foundation stones of any city.

The highly trained personnel of both of these utilities is reaching a high scarcity mark because of present war conditions, therefore, it seems to me opportune for cities to study the problem of combining these two utilities, thereby availing themselves of forced reduced personnel to carry on without necessarily subjecting the department to lower efficiency. In other words, bringing all operation under one over-head and direct management, the two utilities will soon function as a single unit and with less men, who today are at a premium. The place for women in these two utilities is very limited, other than in the office and the laboratory.

Aside from the manpower there are many things common in the operation, maintenance and construction of the two systems. Both have to deal with water, both have to do with pumping stations, treatment plants, and both have to do with distribution and collection pipe systems within the streets. The principal difference is that one is a pressure system and the other a gravity system, both with common hydraulics to apply. Records of both systems must be kept and are not unlike and the two fit into the scheme very well. For instance, one location book is kept. On one sheet is a detail of the water system and on the next the sewer system information, one man in complete control of the two systems.

The Trend Toward Charging for Sewer Service

In the one system water is distributed through a pipe system under pressure to the consumer for which service revenue is received; the other a collecting and disposal system through which nearly 70 per cent of the pumped water is handled and finally disposed of to the river or treatment plant, as waste, from which in our case no revenue is received. Of late, however, many cities are making a sewer rental charge for the sanitary sewer service rendered to consumers, handling the accounting in its entirety through the water office and in most cases basing the charge for the sewer service on the metered consumption of water to the water patron. With this trend toward charging for sewer service, here is another direct operating item that tends to bring these two utilities closer together.

The Question of Operating Personnel

From another and very important angle we find that the construction features of the two systems are alike. The equipment necessary for one is adaptable to the other. The personnel can be so selected as to officiate equally as well with one as the other and better in combination

of the two. I say this advisedly because our entire force has acquired working knowledge of the operation of both systems and that replacement of manpower is of much less concern because of this practice. It is economical because there is hardly any loss of time due to idleness brought about by no work; it is a known fact that men must be available on a minute's notice for emergency work if the proper service is to be maintained, therefore between the two systems operating jointly little or no time loss is experienced as compared to the two utilities operated separately, in which case two crews would be necessary instead of one to do the same work.

While I appreciate the fact that many water works superintendents are not favorable to joint operation of the two utilities, there is a tendency on the part of the government to place the operation of the sewer system under the management of the water department because of the already established water accounting department and because nearly all of the information necessary to carry on the billing of sewer rentals is at hand.

In further justification of my claim that joint operation of the water and sewerage system is preferable from a financial and service standpoint, I wish to cite again the actual setup of the City of Shreveport, Department of Water and Sewerage. I will be as brief as I can but I do want to give figures so that comparisons can be made.

Some Information on the Shreveport Set-up

The population of the City of Shreveport as of December 31, 1941, within the city limits was 103,685. The metropolitan area served by the water department, 120,749; annual pumpage, 3,926,902,000 gallons. Unaccounted for pumpage, 5.5 per cent. Number of miles of water mains, 266.597—2 to 24 inches. Number of miles of sewer mains, 226.144—6 to 30 inches. There are two main pumping and filtration plants, total capacity 16.354 m.g.d., and three booster pumping stations used intermittently during heavy consumption. In the sewer system we have six sewage lift stations, four operating daily and two when certain heights in the river are reached.

The assessed property valuation of the city as of December 31, 1941, was $94,893,510. The annual retirement and interest payment for 1941 on the Department of Water and Sewerage system was $207,473.44, or a millage of 2.184 on the assessed dollar, secured by tax bonds and paid for through taxation. Other than this one item, the city proper has no obligation to meet nor does the city budget one cent of any other expense. Of this 2.184 millage, 1.584 millage is charged to the water system and 0.6 mill to the sanitary sewer system. Under the present setup of the city, the people through taxation pay $207,473.44 per annum for their water and sanitary sewer service and all other items of expense are borne by the Department of Water and Sewerage through the sale of water alone. To bring this closer to home, let us consider a residence assessed at $5,000: From calculation on the above figures obligates an owner or taxpayer to pay annually $10.92 for the privilege of owning in fee and using the water and sewer system. On a $2,500 valuation the taxpayer pays $5.46 per annum for the same privileges. Of the $207,473.44 annually expended as taxes, $56,936.10 or 0.6 mill is chargable to the sanitary sewer system, and if figured on a $5,000 and $2,500 assessment valuation it costs the taxpayer $3 and $1.50 per annum respectively, and that is all the city pays out of public funds for the two utilities. All items of operation and maintenance and improvements are now being taken care of from the earnings and Revenue Bonds negotiated through the city but paid for out of the revenues accruing from the sale of water. In 24 years the Department of Water and Sewerage has put back into the property account in water and sewer mains, etc., $926,175.76, of which 55 per cent represents sanitary sewer improvement, or $509,396.66.

The only source of revenue is from the sale of water at the following schedule of prices: First 50,000 gallons, 25c per 1,000 gallons, next 75,000 gallons 20c, next 75,000 gallons 15c, next 300,000 gallons 10c, and all over 500,000 at 8c. This rate has prevailed since 1912.

Included in the obligation of the Department of Water and Sewerage is the maintenance of the service pipes from the main to the curb, which obligation prior to municipal ownership was the property owners.

All water used by the city for parks, cemeteries, public buildings, sanitation, street department for washing, sprinkling and repair of streets and fire protection is furnished without cost. In addition to this a cash remittance of $100,000 annually is made to the General Fund.

No taxes are paid by the Department of Water and Sewerage nor is a rent charge made for office space occupied.

The department pays all costs involved in repairs to the street which are cut in our routine maintenance or improvement work. Yet no charge is made by the Department of Water and Sewerage for any service rendered the other city departments.

The total bonded indebtedness of the Department of Water and Sewerage covering the life of municipal ownership beginning January 1, 1917, to the close of 1941 was $4,481,373.79, of which $836,600 were Revenue Bonds of the Department of Water and Sewerage. The total bonded indebtedness at the close of 1941 was $2,603,575, showing a retirement of $1,877,789.79. Since 1928 only Revenue Bonds have been issued.

An appraisal of the physical value of the Department of Water and Sewerage properties stand at $3,439,482.47 chargeable to the water system and $1,567,042.24 chargeable to sanitary sewers, or a total of $5,006,524.71, and if compared with the purchase price of the property January, 1917, of $800,000, indicates to me a great deal.

Annual Operating Costs—

In further consideration of the annual cost of the complete operation of the Department of Water and Sewerage, find that for a property assessment of $5,000 the owner-consumer pays $28.92, and on a $2,500 assessment $17.46. An analysis of this cost shows $10.92 is for capital investment, which the City of Shreveport pays for through taxation and $18 representing the average cost of water for one year, making a total expenditure of $28.92 for all charges for these two utilities, including a supply of pure water.

For this insignificant amount ($28.92) the taxpayer enjoys adequate fire protection, and because of which pays the low insurance rate of less than 38 cents per hundred. [According to the National Board of Fire Underwriters, Shreveport enjoys a second class rating of 2.1.] All water for municipal usages is gratis and since 1928 no assessment or property tax has been made against the city property for improvements of either system, all expenses therewith having been cared for through Revenue Bonds and paid for out of the receipts from the sale of water.

I attribute much of the success of our operation here to the joint operation and financing of the two utilities under one management.

DISTRIBUTION SYSTEM STUDIES*

Their Value in the Present Situation and for Meeting Post-War Problems

By E. SHAW COLE
Chief Engineer
THE PITOMETER COMPANY
NEW YORK

OF THE many problems the war has presented to the water works industry there are two which the Pitometer Company's engineers have been proud to help solve. First of these is the problem of conservation of water through water waste surveys to avert serious shortages in many cities. The other, which is the subject of this discussion, is the problem of provision for the adequate distribution of water to meet the increasing demands of war industries and housing developments, in addition to the normal domestic and industrial demands.

Unfortunately, the migration of industry, as well as population, toward the more desirable locations in the outskirts of cities has been greatly accelerated in the last few years by the Federal Housing Administration, the defense and lease-lend boom, and finally the war boom. In Greensboro, Salisbury and Charlotte, N. C., where distribution system studies have recently been completed, the growth in the outskirts created demands that were increasingly difficult to solve. Almost overnight, large war plants have sprung up at great distances from the center of some cities and their demands for water have in many cases imposed a serious if not disastrous load throughout the entire length of a distribution system. In Charlotte, for example, just as the report of the study was completed, the engineers who had made it were advised that a proposed war plant requiring 1.0 mgd. from the city was to be built six miles from the end of the city mains.

Most cities have been able to satisfy the gradually increasing demands in the outskirts of their systems, either with the existing facilities or by making a few extensions; but as industrial activity has increased, many have found major improvements necessary, because of continually poor pressures due to a drop in the hydraulic grade line all the way from the pumping station to the far end of the system.

Fortunately, there was adequate

rainfall throughout the country last summer practically to eliminate the usually heavy lawn-sprinkling demands, so that they were not added to the already large loads. If next summer is dry or even normal, however, there will be many difficult periods of low pressure which it is hoped will not seriously curtail the service to war plants.

Ordinarily, if funds were available, the permanent solution of the problems imposed by the new loads would be easy to solve by the construction of properly designed reinforcing mains, tanks, reservoirs or booster stations. Today, however, these problems must be solved, for the most part, by resorting to the "Save, Stretch and Share" program recommended in a recent issue of the A. W. W. A. Journal. In a few cases it has been possible to obtain high priorities for the purchase of pipe for the supply of war plants. Under either of these conditions a distribution system study is valuable in solving the present difficulties and also in providing a comprehensive plan for post-war public works projects.

Outline of the Pitometer

The Pitometer distribution study is a study of requirements of a distribution system based on definite information obtained from field tests as to the use and need of water, and the ability of the existing system to satisfy the present and future requirements. The future water requirements are estimated by co-ordinating population studies with the water now supplied to the system as a whole, and to its various sections. The present water consumption in the various sections of the city is determined from Pitometer measurements and the probable future population, 15 or 25 years in the future, from analyses of the past growth and the opportunities for a continuation of the same trend.

The actual physical condition of the distribution system is determined by various field tests that are usually made in conjunction with Pitometer flow gagings. These include loss-of-head tests, hydrant-flow tests and a pressure survey. All results are thoroughly analyzed, and are made available for use as a basis for the design of the extensions and reinforcements and for checking hydraulic computations.

Loss-of-Head Tests

As a preliminary to the loss-of-head tests, a 24-hour gaging of the flow is made under normal operating conditions, with the Pitometer on the section of main to be tested and at critical points to determine how the various feed mains operate. Then the test is made by closing all side valves along the section and measuring the flow and loss of head simultaneously. From these measurements the present internal condition, carrying capacity and friction coefficient are determined. This information is extremely important, not only because it gives an accurate friction coefficient for design purposes, but also because economical improvements can often be made by cleaning important mains or by otherwise removing obstructions or bottlenecks. In Salisbury, N. C., for example, a low coefficient on a 10-in. main was later found to be caused by a short section of 4-in. main that created a bottleneck, which reduced the Williams-Hazen coefficient, C, to 41.

In one New York State city, the principal feed main for the system was found to have the very low coefficient of 39. Investigation showed that a broken 20-in. valve was partially closed, so that after the gates had been removed, a retest gave a coefficient of 86. The size of mains needed to reinforce the system was accordingly reduced with definite assurance of adequate support.

In a large midwestern city, plans had been made for a large reinforcing main to feed an industrial area

*This paper, read before the North Carolina Section of A.W.W.A., is being printed by permission of the Association.

in the outskirts to the west of the pump station. Later, Pitometer gagings showed that a large amount of water for the mercantile section, north of the pumping station, reached that area by going first to the west and then back to the north by a round-about route. The obvious remedy for this condition was a feed main directly to the principal mercantile area. This was not only a shorter and cheaper main than originally planned, but, most important, it solved the problem, which the other main could not have done.

Another advantage of the loss-of-head tests, particularly at this time, is that cleaning is one of the few improvements that can be made without priorities or the construction of new mains. Accurate information regarding the condition of the mains will justify the need for cleaning and provide a logical basis for a cleaning program.

Hydrant Flow and Pressure Tests

Hydrant-flow tests made at frequent intervals show the amount of water available for fire fighting purposes and also provide a splendid check on the operation of the system. Occasionally, computations of the strength of the grid do not agree with hydrant-flow tests, a condition which usually leads to the discovery of some obstruction not located by the loss-of-head tests. In addition, weak spots are definitely located and provisions made for suitable reinforcements.

The pressure survey includes sight readings at frequent intervals, and under certain conditions, continuous records are made to obtain information regarding changes in the hydraulic grade line. As with the other tests, this information provides a sound basis for design.

At Charlotte, N. C., certain fixed conditions—the pumping head and the overflow elevation of three tanks—controlled the operation of the distribution system. Normally these tanks floated on the system, emptying during peak demands and filling at night. Recently, because there had been difficulty in keeping these tanks full, careful pressure records were combined with flow measurements to determine the cause. These determinations showed that the maximum demands in the outskirts, near the tanks, had greatly increased until they represented a large percentage of total consumption. As a result there was a large loss of head in the feed mains from the pump station to the center of the city. It was further found that the allowable loss of head from the pumps to the tanks was completely used between the pump station and the downtown section, so that the tanks emptied rapidly in an effort to satisfy the heavy demands in the large area surrounding them.

The solution for this condition was to provide additional supply mains to the center of the high consumption area and from there to the areas drawing on the tanks. In this way a flat hydraulic grade line could be obtained and the tanks could be kept full except that under the peak load periods for which they were designed.

Applications to Design

All these studies and measurements must obviously be correlated and intelligently used in the design of the improvements, to which they are only a preliminary. With the present strength of the system determined as described above, the first step is to obtain the maximum operating efficiency before designing any extensions. This is particularly important now, when critical war materials must be conserved. By correcting any existing faults in the system, the required improvements can be kept to a minimum.

The actual design is divided into two sections: (1) the study and design relating principally to the main feed lines from the source of supply, and (2) the study and design for improvements of the gridiron of the distribution system.

1. Main Feed Lines

Under the first of these divisions it is usual to consider how the water may best be brought, without undue loss of head from friction, to certain sections where it is needed, in sufficient quantities and under all conditions of draft which are likely to occur, as determined in the studies. During the war, the possible means, except where priorities can be obtained, will be limited to the use of existing facilities or to the application of restrictions on the use of water. Cleaning has been mentioned. In addition it may be possible to alter pumping procedure. In some cases direct pumping to reservoirs or tanks during periods of low consumption, by daily manipulation of certain valves, has been helpful. In other cases the transfer of existing pumping equipment to a new site and the formation of a booster district may temporarily solve a serious problem. Still another solution may be by the operation of pumps at a higher though less efficient head, to fill a reservoir or to prevent one from emptying.

Where priorities can be obtained, it is important to use only those mains which are the most urgently needed. These, however, should adequately solve the problem for which the priority was granted and it is highly desirable to have them fit into the long-range program. A distribution study based on field tests provides a rational means for selecting the mains needed now, with the assurance that they will do the job in the most efficient way.

Looking to the future when materials will again be available, however, a study should be made of the effect of tanks or balancing reservoirs, to supply the peak loads due to lawn sprinkling or fire fighting demands, thus reducing the size of mains otherwise needed.

2. Extensions

In the design of the extensions, hydraulic computations are made by use of the best available methods, depending on the particular problem. All methods use the same basic hydraulic principles and all are equally accurate for all practical purposes *if* the proper assumptions are made. With actual information obtained from field tests, there is little danger of making erroneous assumptions. The mathematical methods, though sometimes too laborious, are used in conjunction with other methods for many problems. These computations are made for the period for which improvements are intended, so that it may be known approximately when each of the various items of construction should be undertaken if it is to be ready when needed.

This method of laying out work by a definite program results in an orderly procedure by the water plant in construction of new works. It provides an opportunity to make changes in construction dates for special reasons, such as unexpected pavement construction, with the assurance that the proper size is laid to fit into the general plan. It is this latter feature which will be so important after the war.

Great stress is being made today on the importance of having a public works program which will absorb the slack in industrial activity after the war. Undoubtedly water mains and street pavements will be an important part of this program and past experience with W. P. A. and P. W. A. will emphasize the importance of having on hand a well-engineered program for the construction of future water improvements.

A SIGN of Strength

Slowly, it seems to anxious eyes, but in reality more swiftly than her enemies ever thought possible, America is gathering her strength to strike. And as she moves forward into the world struggle, the qualities that have made her great become more and more apparent. Her vast natural resources, her disciplined efficiency, her tremendous energy and confidence born of freedom—these are the things that will make her as successful in war as she has been in peace.

To Americans, Niagara has always been a sign of this strength, epitomizing in its great Falls the resources, the energy and the freedom in which we take pride. In its beauty, too, the beauty of the American ideal is symbolized. It is one of the many unique natural wonders that express the active and potential power of a free people whose progress is derived from the exercise of their own abilities in a land of opportunities.

We who work within sight and sound of Niagara Falls are devoting every ounce of our energies and facilities to speeding the flow of chemicals for Victory.

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FROM THE ORIGINAL BY DAVID FREDENTHAL . . . IN NIAGARA ALKALI COMPANY'S COLLECTION OF PAINTINGS OF NIAGARA FALLS

Niagara ALKALI COMPANY

60 EAST 42nd STREET, NEW YORK, N. Y.

An Essential Part Of America's Great Chemical Enterprise

KY.-TENN. SECTION MEETS IN PADUCAH

Sees Some of America's First Gravity Type Filters and a Well Managed Paying System

THE Kentucky-Tennessee Section of A. W. W. A. held its 17th annual meeting in Lois Sutherland's and Irvin Cobb's home town—Paducah, Ky., on the banks of the Ohio—October 19-21.

Besides Irvin Cobb as a distinguished son, Paducah has the distinction of having one of the country's best managed water works systems, which was purchased by the city some eleven years ago and has since been efficiently operated under a Board of Commissioners headed by Edwin J. Paxton, publisher of the Paducah "Sun Democrat."

Retiring Chairman
Robert R. Harris, Asst. State Sanitary Engr., Louisville, Ky.

New Chairman
John J. Quinn, Supt. Filtration, Knoxville, Tenn.

In addition, Paducah has the further distinction of having as operating head of its well managed water works a modest little lady with as much charm as ability—Miss Lois Sutherland, who every year at the National Convention has her difficulties persuading those in charge that she really does belong in the operator's line and *not* over at the desk where the ladies are registered. Even after negotiating this hurdle this little lady is more likely than not to come through the "battle" on the registration list as Mr. Louis Sutherland.

So many went down to the Paducah meeting, as hard as it is to get into Paducah from most anywhere by rail, as much to see the sort of water works a lady "super" operates as to attend the meeting. Well, it was all that Miss Lois, long time publisher Paxton and the rest of Paducah's Water Board typifies. And to say that Miss Sutherland proved an ideal "host" hardly needs the saying to any who have met the lady.

Paducah's Filters Amongst Earliest

During the meeting many had an opportunity to visit Paducah's filter plant, which was built in 1903, just two years after the first gravity concrete filters were constructed at Little Falls, N. J. Realizing that the Paducah Water Works dates from 1885, it was not surprising to find many odd and interesting antiques in the way of now obsolete equipment, some of which are here pictured and still are held as standby units. Of considerable interest to this reporter was the air-water wash system in the 1903 Paducah filters. The original system is still in use and has always given satisfactory performance. The same manifold and lateral pipes serve in the distribution of air and water. This writer has always felt that the combination of air-water wash was the ideal filter wash, and if all such systems had been designed on the same basis as the Paducah installation, it seems doubtful that the so-called high velocity water wash would ever have come into use and mud-ball troubles would have been much less a topic for the "Trouble Hour."

Kentucky Dam Visited

The feature on the final afternoon was the trip to Kentucky Dam on the Tennessee River, where members were luncheon guests of the Paducah Water Board. Other than this, the entertainment was held to the Annual Dinner, which was followed by dancing.

Hosts
Edw. J. Paxton, Publisher (Chairman of the Paducah Water Board)
Miss Lois Sutherland (Supt. and Treas., Paducah Water Dept.)
Louis R. Howson, Consulting Engr. (Long served the old Water Co. and now the Water Board)

McCord Voted Fuller Award

During the dinner it was announced that C. M. McCord, Director of the Division of Water, Memphis, Tenn., had been chosen as recipient of the Fuller Memorial Award, "in recognition of an active leadership in the Section and for his contribution towards advancing public relations in water works practice as represented by his preparation of a concise explanation of water metering for distribution to consumers." It was noted that this explanation had been published in booklet form and sold to water utilities, the profits from such sales being devoted by the author to the parent association for use in advancing metering practices.

Honored
C. M. McCord, Director, Division of Water, Memphis, Tenn. (Voted the Fuller Award)

Secretary
H. D. Schmidt, Chief Engineer, State Dept. Health, Nashville, Tenn. (Also A.W.W.A. Director)

Officers

The following were chosen as officers for the ensuing year:

Chairman

John J. Quinn,
Supt. of Filtration, Knoxville, Tenn.

Vice-Chairman

Clark Cramer, Chief Engineer,
Lexington Water Co., Lexington, Ky.

*Secretary-Treasurer**

Howard D. Schmidt, Chief Engineer,
Tenn. State Dept. of Health, Nashville, Tenn.

Trustees

B. E. Payne, Chief Engineer,
Water Department, Louisville, Ky.
G. R. Kavanagh, Distr. Mgr.,
Wallace & Tiernan Co., Knoxville, Tenn.

*Mr. Schmidt is also serving on the A. W. W. A. Board as Director from the Ky.-Tenn. Sections.

Technical Sessions

The meeting was opened by the Mayor—P. E. Lackey—who had a high regard for water works and water operators. He was followed by R. M. Shelbourne, as the Water Board's attorney, who gave a glowing appraisal of the worth of Paducah's water works and accomplishments during 11 years of municipal ownership under Water Board control without political interference. Now a $2,000,000 property, profits from operation had accrued every year to build the present surplus of $422,000 after bond interest. In 1941 the profit was $45,216, from gross income of $246,000 collected from 100 per cent metered water sales. With almost the same income in 1931 ($205,000) the profit was less than half, namely, $21,000. During the same period pumpage had increased only from 2.37 mgd. to

Programmers

F. T. Redman, Chemical Engr., Calgon, Inc., Pittsburgh, Pa.

Homer E. Beckwith, Engr. and Dist. Mgr., The Pitometer Co., Pittsburgh, Pa.

A. E. Griffin, Development Engr., Wallace & Tiernan Co., Newark, N. J.

3.37 mgd. Such a record would stand on its own as evidence of efficient management, said Mr. Shelbourne.

Henry M. Gerber, General Manager, Louisville Water Works (still referred to locally as the Louisville Water Co.), in responding to the Mayor's and Mr. Shelbourne's welcome, proved to be something of an orator in his own rights and concluded with high tribute to Miss Sutherland and Earl Mitchell, Supt. of Filtration, who had become regular attendants at the Section's meetings and the Association's National Conventions.

"The Paducah Water Works," by Louis R. Howson, Alvord, Burdick and Howson, Engrs., Chicago.

Mr. Howson, who in years past had served the old Paducah Water Co. as Consulting Engineer, was also retained by the city when the properties were purchased, which is something of a distinction when realizing that he served on the water company's side during the valuation and arbitration hearings incident to the purchase by the city.

Clark J. Cramer, Plant Supt., Lexington, Ky. (New Vice-Chm'n of the Section)

H. C. Mitchell, Plant Supt., Paducah, Ky. (Grew up with Paducah's W. Wks.)

Mr. Howson gave the highlights of the history of the 57 year old Paducah Water Works, which dates from 1885, with an intake out in the Ohio River and delivering the raw product into the system until 1903, when the filter plant was added and represented the second installation of gravity type concrete filters equipped with air-water wash. Mr. Howson pointed out that up to the flood of floods (1937) the Paducah Water Works had operated with absolutely uninterrupted service for 52 years—quite a record.

Of interest are the intake lines which run under the Tennessee River of less satisfactory quality chemically and out into the Ohio. A parallel 6-inch high pressure line, terminating at the screens of the intake with cleaning jets, has satisfactorily served 40 years in forcing trash or ice from the screens. In 1925 under private ownership, when only 3 per cent of the services were metered, the pumpage averaged 6 mgd., whereas under present 100 per cent metered services the average is but 3.3 mgd. The original wrought-iron standpipe of 1885 is still in use and excellent state of preservation, although the main storage is the 5 mg. concrete reservoir built in 1938.

In referring to the Paducah Water Works as a truly pioneering enterprise, Mr. Howson cited some of the pioneering attainments. Amongst these was the interesting franchise of 1925 given the water company and termed a "Cost Plus Fair Return Franchise," allowing 1 per cent depreciation plus a 7½ return on invested capital and surplus above $25,000 going to the city. In turn, the city paid $10 rental per hydrant and 1.25 cents per inch-mile of mains for fire service. The latter proved incentive for replacements of undersized mains. (At present Paducah enjoys the highest rating of the Fire Underwriters.) For street sprinkling 66 metered fire hydrants were used.

As to pioneering in the plant, Paducah had some of the very first turbo-centrifugal pumps developed by De Laval and installed in 1908. The original units are in standby service as part of the 18 mgd. pumping capacity provided by recent installation of modern turbo-centrifu-

Programmers

Louis A. Geupel, Engr. and Supt., Water Department, Evansville, Ind.

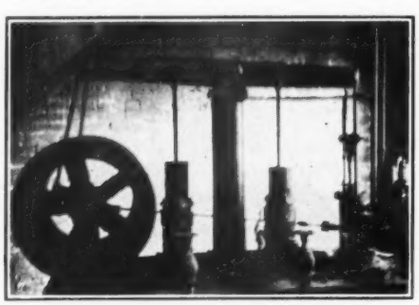
W. W. Towne (Major), Regional Engr., U.S.P.H.S., Cleveland, Ohio

James R. Brown, District Manager, National Water Main Cleaning Co., Chicago

gals. Mr. Howson referred to the early gravity concrete filters of 1903 as more pioneering and the Paducah built proportional chemical dry feed machine is thought to represent the first of its "breed" in America—see accompanying picture. The coagulation basins were provided with multiple hopper bottoms and quick-operating valves.

Mr. Howson was high in his praise of the management by a three member Water Board elected for life and the ability of Miss Lois Sutherland as the operating executive—a unique circumstance, representing more and fruitful pioneering.

H. C. Mitchell, Plant Superintendent at Paducah, and his son, Earl Mitchell, Supt. of Filtration, related experiences during the 1937 flood, when the Ohio was over the plant for 21 days and the plant was out but 25 days. Interestingly, 2 ft. of water was left in the reservoir after the 25 days of turning it into the system for 15 minutes daily. Full water service had been resumed before evacuees were able to return to need it.



A Museum Piece

Still standing in the Paducah plant is this interesting old pump used for feeding chemicals. Elsewhere with this report is a picture of Paducah's first dry feed machine, designed and built by Paducah Water Co. engineers

(1) (2) (3) (4) (5)

(1) *Harold N. Jernigan, Dist. Manager, Wallace & Tiernan Co., Lexington, Ky.*

(2) *R. L. Hurst, Chemist, Water Dept., Owensboro, Ky.*

(3) *W. Scott Wilkie, Sales Engr., Calgon, Inc., St. Louis, Mo.*

(4) *Albert M. Holman, Chemist, Water Dept., Covington, Ky.*

(5) *Chas. N. Beatty, Sales Engr., Vogt Bros., Louisville, Ky.*

"On the Water Front"

This was the topic which many came to hear discussed by Harry E. Jordon, Executive Secretary of A. W. W. A., who considered it "a first" to attend as many sectional meetings as humanly possible since the appearance of the revised P-46 Order of W. P. B. and explain its meaning to the water works industry. The order had just been issued at the time and he came fresh from Washington to explain it and answer questions.

He told of the good news that priority ratings had been increased for water works—the A-2 for distribution system maintenance and repair and the AA-5x for emergency and breakdown needs. Then he told of the added restrictions placed in the new order which have been reviewed in the editorial in our October issue. In brief, a water utility is not restricted on the production end (treatment and pumping) in respect to inventory carried but inventories of distribution materials and equipment must be reduced to 60 per cent of the 1940 inventory. What's more only 60 per cent of the latter figure can be purchased new and the balance most come from another water utility which has the surplus to dispose of after ear-marking the legal 60 per cent of 1940 inventory to hold in stock. It was Jordan's suggestion that this division of inventory be made promptly. For those who had no recorded inventory in 1940 or who may have had one abnormally low, Mr. Jordan gave as a guide the A. W. W. A. figure for the average 1940 inventory in dollar value for the 200 larger plants, which was supplied the W. P. B. and on which the new order is based. This inventory value was approximately $324 per 1000 population for distribution materials. This base would permit (60 x 324) or approximately $195 as the 1942-'43 inventory. Of this figure only 60 per cent could be expended in new materials — namely, only $117 for the year as contrasted with $324 in 1940 and subsequent years to date. The balance allowable inventory to be purchased from other water utilities was the difference—or $78 per 1000 persons served by the department or company.

Mr. Jordan warned that the extensions of mains was out except for camps, war industries and housing developments. Even if the applicant should lay his pipe up to the existing main no more connections are permissible for the present at least and in respect to housing developments he warned against ordering pipe until positively assured that the project is going through. He advocated demanding a photostatic copy of the official authorization of such housing projects before ordering pipe.

"Louisvillains"

Wm. H. Lovejoy, Supt. Filtration (Chairman of the Program Committee)

H. M. Gerber, General Manager, Louisville Water Works (Proved considerable of an orator in his own rights)

B. E. Payne, Supt. & Act. Chief Engr., Louisville Water Works

In reply to questions Mr. Jordan stated that where materials are not available from neighbors, a PD-1A form should be filed for anything over the 60 per cent permitted to be bought from manufacturers or distributors. Of course, emergency materials may be ordered under the AA-5X rating. For maintenance and repair that is not considered in the emergency classification copper can not be had, since it requires an AA-3 or better rating. In the final analysis if in doubt or if in serious difficulties get the water division of W. P. B. on the phone by calling the Washington number Republic 7500 and asking for Extension 5774 and tell your story to waterworks men now on the job there to see that everybody conserves but that nobody suffers in such an essential as water supply is. It is a matter of every man on his own honor from here out.

Production materials (treatment and pumping) are given the same AA-5 rating as distribution, maintenance and repair. The major difference is that the 60 per cent limitation does not apply to production. It must also be recalled that the 1940 inventory for distribution as well as production can be increased in the base in proportion to increased water demand where there has been such since 1940.

Concerning sewerage ratings and requirements, Mr. Jordan explained that the same ratings for water applied in sewage collection (sewers) and sewage pumping and treatment, referred to as "production." With the revised Oct. 10th order sewerage is being handled in the Governmental Requirements Branch whereas all water items are handled *wholly* by the Power Branch. [Note: A new P. 46 Order is now being written for sewerage expressly and this to be known as P. 46-S will avoid confusion in the future. The requirement that only 60 per cent of 1940 inventory can be carried will not apply in operation and maintenance of sewerage facilities. — L. H. E.]

Mr. Jordan stressed the high importance of "Mutual Aid" in the present requirements as it is being developed. The State or Regional Water Coordinator would be the logical "clearing-house" in the redistribution of the 40 per cent surplus stocks in his territory.

Mr. Jordan stated that no water works keyman should consider himself a slacker by remaining on the job. "The Water Front" is an important part in the war effort. To avoid losing such hard to replace keymen every water works manager should apply for their deferment by filing an A-42 form with the local draft board before the man is actually called.

Major D. W. Evans, Regional Officer, O. C. D., Atlanta, Ga., at this point called attention to the serious-

ness of water works operators leaving the job to enter the more glamorous uniformed services. He also stressed the patriotic duty of remaining on "The Water Front" by citing the plight of one community which had let its water works staff slip away and now the superintendent had decided that he would find life easier in the armed services than in remaining on the job with a wholly inexperienced staff to work with.

This focused attention on the importance of inservice training of auxiliaries for water works jobs and the desirability of placing deferment requests on key men before it is too late. In the early stages of O. C. D. planning and organization the water works superintendent was the "forgotten man." His importance was underestimated but this situation was being corrected as rapidly as possible.

Round Table on War Problems

The New Wartime Alum was reported on by W. H. Lovejoy, Sup't. of Filtration at Louisville. As far as his experience went the socalled low grade high insoluble product did practically the same job as the prewar alum. The only point of concern was the insolubles (5% to 15%) which might settle out in feed lines to give trouble. However, a mud-box might be installed ahead of the line to permit the heavier material which would deposit in the line to drop out.

John Quinn, Sup't. of Filtration at Knoxville, Tenn., stated that their first can of the wartime alum contained 8 per cent insolubles (specs. limit at 15%) and 15.25 per cent alumina. The iron content was not given but up to 3 per cent is permitted.

Linn Enslow, editor, WATER WORKS AND SEWERAGE, predicted that based on his experiences with the socalled mud-alum in previous years there would be many who would find it more effective than the higher grade product. As far as the iron content was concerned, if sufficient to allow iron to pass through the basins a simple remedy is prechlorination to oxidize the iron and cause it to precipitate whereas in the ferrous form it frequently does not.

(1) (2) (3) (4) (5)

(1) *J. W. McCoy, Supt. Filtration, Madisonville, Ky.*

(2) *Wm. J. Lyman, Southern Manager, Nat'l Cast Iron Pipe Co., Birmingham*

(3) *R. J. Mottern, Commissioner, Public Works, Bristol, Tenn.*

(4) *J. B. Bye, Business Mgr., Bureau of Water, Knoxville, Tenn.*

(5) *W. H. Johnson, Supt., Water Dept., Harrodsburg, Ky.*

Non-Critical Service Line Materials was the second item discussed.

L. R. Howson, Consulting Engineer, Chicago, stated that lead was still available without restrictions and that the lead alloy "Tubeloy" had been used satisfactorily as a copper substitute. Repeated freezing and thawing of "Tubeloy" (or lead) lines might result in a permanent stretch of the metal and might possibly be of consequence if repeated freezing was experienced.

Steel pipe coated inside and out with bituminous enamel and wrapped on the exterior had been giving a good account of itself. Experience had proved it desirable to have the exterior wrapped for greater protection, and not depend upon the enamel alone. Just an inexpensive thin muslin binder has held up for 20 years.

B. E. Payne, Chief Engineer, Louisville Water Works, reported that "Tubeloy" is not as easy to bend as copper tubing. They were using it with flared joints. Because of its greater wall thickness special flaring tools were required since the copper flaring tools were not satisfactory. For a Defense Housing Project "Tubeloy" was to be used. At Louisville ⅝ inch copper tubing is still being used to a limited extent. To conserve one line is used for two services, the two miters being located in a single miter vault. This scheme saved fittings and miter box materials also.

Wm. W. Brush, editor, "Water Works Engineering," commented that plastic tubing is now available in sizes from 2 inch down.

L. H. Enslow, added that cement lined steel pipe had been used for many years on agressive New England waters in sizes down to ¾ inch, or possibly ⅝ inch. He had known of cases where the pipe had been almost reduced to lace by soil attack but the cement lining had not given way under the pressure.

At this point *B. E. Payne* (Louisville) commented on the urn "Fibrex" jointing material as a jute substitute. They had tried this sterile impregnated paper "yarn" and his foremen liked it.

On Saving and Stretching

"The Effect of Water Waste on Power Consumption," by Homer E. Beckwith, Engineer and District Manager, The Pitometer Co., Pittsburgh, Pa.

Mr. Beckwith, in one of his customarily well conceived and presented papers, brought home to his listeners the importance of curtailing leakage of expensively produced water and particularly so in the present circumstance where waste of power, chemicals, and wear and tear on equipment is to be avoided. What's more the demand for water in the war effort is to be considered and conservation and waste elimination should be the order of the day if the water industry is not to be found wanting in a critical period.

In highlighting what recent Pitometer Co. waste and leak surveys had uncovered in the way of water losses and reduced pumpage expense (power and machinery as well as water conservation), Mr. Beckwith

Earl Mitchell, Supt. Filter, and W. J. Decker, Jr., Asst. Treas., Paducah Water Board

F. S. Kay, Water Engr., and M. L. West, Chemist, Kingsport, Tenn., Water Dept.

R. W. Pritchard, Mgr., Water and Light Dept., Winchester, Tenn., and Zeke A. Stanfield, Ptsbrg.-Equit. Meter Co., Memphis, Tenn.

commented that most water works men did not suspect to what extent leakage could occur without visible evidence of such. He cited various case records of astoundingly large hidden leaks under paving — the largest on record being at the rate of 2 mgd. He told of the impressive pumpage reductions in Philadelphia and Pittsburgh (30 mgd.) which came out of recent surveys made by his company. He also told of a small gravity system supplemented seasonally by pumping. Leak location and correction had made pumping no longer necessary. The saving of the high cost of seasonal or interval pumping made a large difference in the balance sheet. Another case involved corrections of only 15 per cent of the daily consumption hit this figure represented 30 per cent of the daily pumpage, making the saving more than the cost of 15 per cent of the total consumption.

Mr. Beckwith also covered the matters of having pump efficiencies checked, since it was good practice in normal times but far more important practice in these days when one's motto should be "Efficient operation on the water front," as well as in war industry and on the fighting front.

J. B. Bye, Business Manager, Knoxville, Tenn. Water Dept., related the highly profitable results from a Pitometer Co. survey of the Knoxville system, which has been continously followed by nightly geophane work. Amongst other things the Pitometer survey had revealed important water stealing for which $6,000 was collected.

"Water Main Cleaning in the War Effort" — by Clinton Inglee, President, Nat'l. Water Main Cleaning Co., New York City.

Mr. Inglee's paper constituted the stretch part of the "Save, Stretch and Share" slogan introduced by A. W. W. A. and taken-up by patriotic water works men everywhere. Mr. Inglee being unable to be in two places at one time, sent Jos. R. Brown, National's Chicago Manager, to read the paper.

Mr. Inglee's brief discussion showed how important main cleaning can be in reducing power costs for pumping and in making present choked mains do increased duty at this time of needed conservation of both pipe and power. Case histories revealed accomplished results from cleanings. Then followed a set of curves revealing the comparative costs of recovery of pipe line capacities by mechanical cleaning as against laying new supplementary

H. A. Moffat, Sales Engineer, Industrial Chemical Sales Div., Cleveland

E. L. (Lou) Cantrell, Dist. Mgr., Neptune Meters, Louisville, Ky.

Wm. E. Phillips, Dist. Mgr., Mathieson Alkali Works, Chicago

mains or the replacement of assumedly under-sized mains to provide the same capacity as that of the cleaned main.

Mr. Howson, commented that the interior of mains do not have to break very bad before there is a potential benefit from cleaning. He cited a case where an extra bad looking 12″ main had been cleaned. The result was the same in water delivered as if a new 8″ main had been laid parallel to the old 12″ line. In other words this main was "stretched" to a considerable degree by the cleaning.

H. B. Payne told of the cleaning project at Louisville to raise the 86 mgd. capacity to 100 mgd. for mains between the river and the filter plant. In power saved the job will be paid for in 3½ years, but more important was the added capacity for which a larger main had been contemplated before this war changed matters.

"Keeping Mains Clean With Calgon," by F. T. Redman, Chemical Engineer, Hall Laboratories, Pittsburgh, Pa.

Mr. Redman after reviewing the value of Calgon as a preventer of calcium deposits in pipe lines, meters or household piping, reviewed its usefulness in preventing the precipitation of iron in pipe lines and suppresion of corrosion and tuberculation of mains. To secure positive supression of corrosion he advocated starting with an ample dosage of 5 ppm. and, after about two weeks, gradually reducing it until the permissible minimum is determined. To prevent precipitation of iron 1 ppm. of Calgon for each like quantity of iron present was prescribed. To prevent calcium carbonate precipitation 2 ppm. dosage is ample. In checking interior pipe attack through "Calgonization" high velocity (turbulent) fluid is desirable, since it brings the inhibitor more continuously in contact with the metal.

Cleaning Filters With Sulphur Dioxide

"Cleaning Filter Sand in Place with Sulphur Dioxide," by H. B. Channon, Chemical Engineer, Virginia Smelting Co., Norfolk, Va.

In Mr. Channon's absence the sulphur dioxide process of cleaning filter sand in place was described by H. A. Moffat of Industrial Chemical Sales. Briefly the procedure consists of inverting 100 lb. steel cylinders (like chlorine cylinders) and feeding the liquid sulphur dioxide through a rubber hose into the filter manifold while the filter is slowly being filled with water. When the charge is all in the resulting sulphurous acid solution is recirculated over night by means of a small pump. The acidic reducing agent loosens deposits surrounding the sand grains, which subsequent back-washing removers. To determine the charge of SO_2 required laboratory tests are first made.

Mr. Moffat then related experiences at the Louisville, Ky. plant in treating a 6 mgd. filter for removing deposits of manganese and iron. To secure the 1 % SO_2 solution found to be required in the laboratory tests took 3,000 lbs. of sulphur-dioxide, required 8 hours for filling and an 8 hour contact with recirculation. The following day the unit was washed until the wash-water was at the neutral point—pH 7. To recondition this large (6 mgd.) filter required a total of 3 days and $400 expenditure as compared to 6 weeks for manual cleaning at cost of $1,200.

Mr. Lovejoy stated that brass pip-

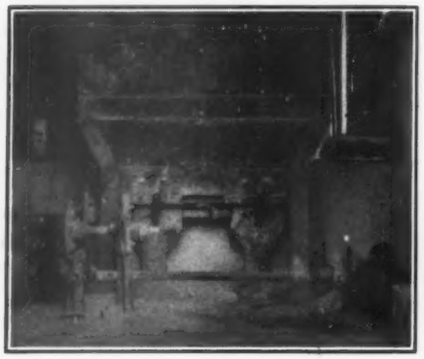
Wm. C. Noyes, Pittsburgh-Nat'l Meters, Nashville, Tenn., and Joseph W. Lovell, Supt. of Water, Murfreesboro, Tenn.

Floyd V. Johnson, Mueller Co., Nashville, Tenn., and Larry Lingnor, "Water Works & Sewerage," Chicago

Elmer Smith, General Supt., and Glenn Lovern, Commissioner, Water Department, Owensboro, Ky.

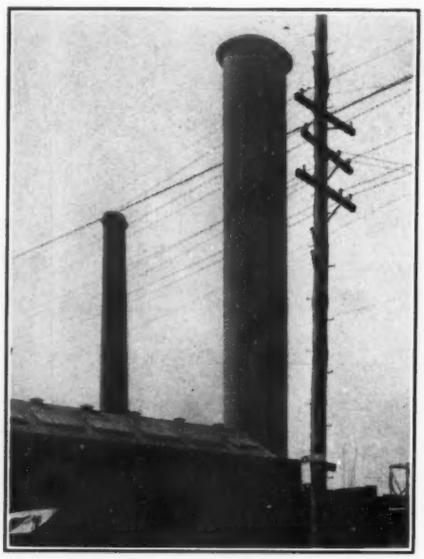
ing was O.K. for the sulphur dioxide feed line. He did not consider the results equal to manual cleaning and overhauling but was much quicker and cost far less. He believed the job could be repeated in 2 days. From his experience he would never use underdrains of ferrous metals again. The laterals had been cement lined and brass eyelets placed in the orifices, however the gravel around the orifices had formed agglomerates with iron as the binder.

This led into a discussion of various filter bottoms including non-corrosive Transite and red-brass laterals, the Wheeler bottoms and Alexite porous plate bottoms.



America's First Dry Feeder?

Thought to be such, this proportioning feeder designed and built by the former and present plant "supers—Holmes and Mitchell—was put in operation in 1912. The speed varying paddle wheels are not visible but the change gears on the left are.



Something Historic in Standpipes

Erected in 1886 as part of the original plant, this 56-year-old standpipe has been adjudged to have at least another 56 years of useful life. Fabricated of riveted W. I. plates (bottom plates 9/16 in., top 3/16 in.), this 22 ft. diam., 175 ft. tower has since been cut down to 125 ft. and serves as a wash-water tank and reserve storage.

"The Doctor"

Who ever heard of a boiler room having a "doctor"? Paducah's does, though. Too bad cramped quarters and little light prevented a better picture of this historic unit behind the boilers. This is a steamboat type boiler feed pump from an old Ohio River packet. It has a fancy fluted chamber, walking beam, and all. Rivermen have always referred to this dependable feed pump as "The Doctor."

More of the Historic in Paducah's Water Works

Mutual Aid

"The Mutual Aid Program in Indiana," by L. A. Geupel, Superintendent, Water Department, Evansville, Ind.

Mr. Geupel highlighted the workings of the Mutual Aid Plan in Indiana which had been started as an Indiana section activity shortly after the 1937 Ohio floods when an Emergency Water and Sewage Committee was established early in 1939 under Mr. Geupel as chairman. The state was zoned and a zone chief appointed for each. The pooled inventory scheme was tried but was only about 40% effective due to reluctance of private companies to release their inventories. On Sept. 7, 1941 the committee was sworn in as a State Defense Unit and 19 zones with coordinators were established. The inventory survey was completed and the key list is held in the State Dep't. of Health vault.

In an emergency the procedure is for the operator to call his zone coordinator who has a record of inventories in his zone. If necessary he in turn calls the State Coordinator to locate the needed material at the nearest point.

Under the committee a Defense School has been held at Purdue University and an Emergency Procedure Bulletin has been issued to every water works in the state.

Mr. Geupel stressed the value of the spirit of comradeship in the Mutual Aid Plan, and the fact that association meetings had brought this comradeship about. He also stressed the importance of training auxiliaries against the time of possible need.

W. W. Towne, Major U. S. P. H. S., attached to the O. C. D., said that early mistakes were made in the Civilian Defense program — one being that volunteer personnel could operate the water works in a disaster. He pointed, however, to the importance of water works authorities working with the local Defense Council and the necessity of having proper identification for employees called out in an emergency. He congratulated Indiana on the progress made in Mutual Aid which started in 1939.

W. B. Payne, Chief Engineer, Louisville Water Works, reported that his experience in a mock raid was that the head of a utility did not belong in the Control Center during a disaster, but in his own office with an assistant at the Control Center.

R. R. Harris, Ass't. Engineer, Ky. State Dep't. of Health, reported that an inventory in Kentucky had gotten under way but was only about 30% completed.

Howard Schmidt, Secretary and Director of the Section, reported that plans had been started for an in-training service program for both Kentucky and Tennessee.

Other Papers and Discussions

"Can American Water Systems Provide for Civilian Defense?" was the title of a paper read by J. R. Snyder, of the Kentucky Acturial Bureau. The paper was that written on this topic by K. J. Carl of the National Board of Fire Indemnities and published in the May, 1942 issue of WATER WORKS AND SEWERAGE. It revealed that for water supply to fail completely would take an air blitz which would seemingly prove impossible in America. No ordinary raid would knock down pressures to where fires in residences started by incendiary bombs could not be extinguished.

R. D. Sheldon, Industrial Salvage Section of W. P. B. outlined the metal salvage program under way and made a plea for water works scrap.

Harry Jordan warned, however, against scrapping that might be considered obsolete equipment which another water works might have need for in view of being able to get anything better. Such equipment should be reported in the inventory listing supplied W. P. B., with the maker's name, etc.

"Hazards of the Orthotolidine — Chlorine Reaction," were briefly pointed out by A. E. Griffin of Wallace and Tiernan Co.'s, Develop-

mental Department. In brief the operator can be greatly misled in testing for high residuals unless the quantity of orthotolidine reagent is ample. For details the reader is referred to the article on "The Determination of High Chlorine Residuals," by N. S. Chamberlin (an associate of Mr. Griffin), in the November issue of WATER WORKS AND SEWERAGE.

During the annual dinner, H. A. Moffat of Industrial Chemical Sales showed the interesting color film movies of the Chicago Wartime Conference of A. W. W. A. taken by "Art" Welch of the the same company.

MEETINGS OF THE SANITARY DIV. OF A.S.C.E. AND THE N. Y. STATE SEWAGE W'KS ASS'N

New York City — January 21 and 22

IN ACCORDANCE with long established custom, the annual meeting of the N. Y. State Sewage Works Assn. will follow the annual meeting of the Sanitary Division of the A. S. C. E. in New York City in January. The Sanitary Division will meet in the Engineering Societies Building at 33 West 39th Street, New York City, on Thursday, January 21. The Fifteenth Annual Meeting of the N. Y. State Sewage Works Assn. will be held at the Hotel McAlpin on Friday, January 22. On the same evening will be held the Joint Annual Dinner of the Sanitary Division and the New York Association.

The programs of both groups, as indicated here, recognize fully the opportunities for these wartime conferences. A special innovation will be the forum on "The Influence of the War on Sanitary Engineering," which will be a part of the Joint Luncheon of the New York Association and the Sanitary Division on Friday, January 22. This will be led by Linn H. Enslow, editor of WATER WORKS AND SEWERAGE, and consultant to W. P. B.

At the Friday night Joint Banquet, the president-elect of A. S. C. E., Major Ezra Whitman, will be the special guest, and Secretary Seabury will be on hand. Abel Wolman, Professor of Sanitary Engineering at Johns Hopkins University, and President of the American Water Works Association, will be the featured speaker of the evening. His topic will be "What of the Sanitary Engineer in the Post War Era?" and timely comments on national development of today.

To further brighten up the occasion, William J. Orchard will act as Master of Ceremonies and "Director General of Entertainment."

PROGRAM OF THE
SANITARY DIVISION, A. S. C. E.
(Engineering Societies Building)

Thursday Forenoon, January 21

"Waste Disposal in Army Cantonments," J. L. Vincenz, Washington, D. C.

"Performance of Final Settling Tanks of Novel Design," Richard H. Gould, New York City.

"Developments and Progress in Water Supply Practices," Report of Committee on Water Supply Engineering, Thomas H. Wiggin, New York City.

Thursday Afternoon

"Calculating Coagulant Requirements in Sludge Conditioning," A. L. Genter, Baltimore, Md.

Discussion by Paul D. McNamee, Washington, D. C.

"The Practice and Economy of Sludge Concentration," (a Symposium).

R. F. Goudy,
Los Angeles, Calif.

C. E. Keefer, Baltimore, Md.
W. Donaldson, New York City.
William Rudolfs, New Brunswick, N. J.
E. T. Killam, New York City.

PROGRAM OF THE
N. Y. STATE SEWAGE WORKS ASSN.
(Hotel McAlpin, New York City)

Friday, January 22

Forenoon

Annual Business Meeting.

"A Sewerage Project Designed Without Critical Materials," Paul E. Langdon, Chicago, Ill.

Discussion by A. M. Rawn, Los Angeles.

Noon

Joint Luncheon with Sanitary Engineering Div., A. S. C. E.

Presentation of Awards.

"The Influence of the War on Sanitary Engineering" (a Forum).

Linn H. Enslow, Leader

Participants

Charles A. Holmquist, Charles G. Hyde, William M. Piatt, George J. Schroepfer

Afternoon

"Vacuum Flotation of Sewage and Industrial Wastes," Dr. A. J. Fischer, New York City.

Discussion by Dr. Harry W. Gehm, New Brunswick, N. J.

"Grease Removal by Flotation," Capt. Ralf Eliassen and H. B. Schulhoff, New York City.

Discussion by W. Donaldson, New York City.

"Overhauling a Methane Gas Holder," C. George Anderson, Rockville Centre, N. Y.

Evening

Annual Joint Dinner of Sanitary Engineering Division and N. Y. State Sewage Works Assn.

(Linn H. Enslow, Presiding. Wm. J. Orchard, Master of Ceremonies.)

Speaker—Abel Wolman, Professor of Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

Honored Guests—The President-elect of A. S. C. E., Major Ezra B. Whitman, and Exec. Secy. of A. S. C. E., George J. Seabury.

Entertainment.

[Note: Because of present conditions and transportation difficulties, the customary joint trip of inspection on Saturday following the meeting and dinner will not be held this year.]

WATER MAIN CLEANING IN THE WAR EFFORT*

By CLINTON INGLEE
President
NATIONAL WATER MAIN CLEANING CO.
NEW YORK

THE Government has urged that all possible steps be taken to conserve critical materials. If current newspaper articles can be depended upon, manpower is also becoming a critical problem and the situation in that respect will become increasingly acute. Hence, anything that will conserve both materials and manpower will further the war effort.

It is obvious that the deferment of laying new mains, perhaps indefinitely, would result in large savings in both labor and materials. Thus, if requirements for increased capacity can be filled by the restoration of mains to their original capacity, the cleaning of old lines will certainly defer the laying of new mains, since cleaning will effect such restoration.

The methods and results of main cleaning have been described in numerous published articles, but it may be well to review the procedure briefly in the light of the present situation.

Mechanical cleaning requires opening the pipe in two places, inserting the cleaning machine and making up the pipe at place of entry, setting a riser pipe with a 45-degree bend at the other end of the run, propelling the machine through the pipe by water pressure or by cables (hand or motor-drawn), and, finally, after emergence of the muddy water and the machine at the exit, shutting off the water, removing the riser pipe and reconnecting the main. The footage of pipe which may be cleaned in a single day will depend upon such factors as the amount and nature of the incrustation, tuberculation or deposit, the water pressure available, the layout of the system and the facilities for the discharge of wash water and, not least important, upon the efficiency of the working crew. Prompt shut-offs and rapidity of cutting and making up determine whether one or more shots can be made in one day.

Mains of the smaller diameters cannot always be pressure-cleaned, but usually in 8-in. and larger pipe the pressure-driven cleaning machines can be employed.

*This paper, read before the Kentucky-Tennessee and North Carolina Sections of A.W.W.A., is being printed by permission of the Association.

TABLE 1
Man-hours Required for Cleaning Mains

1	2	3	4	5
Main Diam.	Length of Main Cleaned per Day Minimum	Maximum	No. in Crew	Average Maximum Manhours per Mile*
in.	ft.	ft.		
4	600	1,500	6	422
6	600	2,000	6	422
8	1,000	5,000	6	253
10	2,000	8,000	8	169
12	2,000	30,000	8	169
16	2,000	30,000	10	211
20	2,000	30,000	12	252
24	2,000	30,000	12	252
30	2,000	30,000	12	252
36	2,000	30,000	12	252

*Based on figures in column 2.

TABLE 2
Man-hours Required for Laying New Mains

1	2	3	4	5*	6†	7‡	8‡	9	10§	11	12
		Material Removed per Mile of Length		Man-hours Hand Digging		Manhours per Mile Machine Trenching					
Main Diam.	Width of Trench	3-ft. trench	5-ft. trench	3-ft. trench	5-ft. trench	3-ft. trench	5-ft. trench	Man-hours Laying Pipe	Man-hours Backfilling 3-ft. Trench	Sums of Columns 5 + 9 + 10	Sums of Columns 7 + 9 + 10
in.	ft.	cu.yd.	cu.yd.								
6	1.5	880	1465	700	1300	59	98	264	440	1404	763
8	1.65	968	1615	775	1435	64	108	295	484	1554	843
10	1.83	1070	1780	860	1580	71	119	365	535	1760	971
12	2.	1175	1960	940	1740	78	131	440	587	1967	1105
16	2.34	1372	2290	1100	2040	92	152	490	686	2276	1268
20	2.67	1592	2610	1270	2320	106	174	575	796	2641	1477
24	3.	1760	2930	1410	2610	117	195	705	880	2995	1702
30	3.5	2050	3420	1640	3020	136	228	880	1025	3545	2041
36	4.	2350	3910	1880	3430	157	260	1145	1175	4200	2477

*Based on man rating at 10 cu. yd. per 8-hr. day, or 1.25 cu. yd. per hr.

†Based on man rating at 9 cu. yd. per 8-hr. day, or 1.125 cu. yd. per hr.

‡Based on cubic yards of material removed by machine with 2 men digging 800 ft. per day, 2 ft. wide, 4½ ft. deep, or approximately 30 cu. yd. per hr. This is probably much better than average.

§Based on man rating at 16 cu. yd. per 8-hr. day, or 2 cu. yd. per hr.

Whether the smaller pipe is cleaned by the cable or the rotary method, the length to be cleaned in a single operation will depend upon the kind and location of bends and tees. In mains which are cleaned by pressure-driven machines, the factor of location and kind of bends is not too important, for the cleaning machines readily pass through 45 and 90-degree bends, except if two 90-degree bends are placed close together to make an offset, in which case it may be necessary to cut the pipe at that point.

The amount of pressure work which can be done in a working day is determined by the efficiency of the crew, which must cut and make up the line before and after the cleaning operations. The pressure cleaner should travel at a rate of approximately 100 fpm., i.e., at a little more than 1 mph., so that it cannot be expected to clean more than about 5 miles of pipe in a working day. With overtime, however, it is possible to make even longer shots, the longest one, to the author's knowledge, being the cleaning of some 70,000 ft. of 12-in. cast-iron pipe at Cleveland, Ohio.

Comparison of Manhours for Cleaning and Laying

Under average conditions, it may be expected that the amount of pipe cleaned per working day will be approximately as shown in Table 1, from which, for purposes of comparison, only the minimum lengths of pipe, as shown in column 2, are used to derive the averages of column 5. Obviously, if longer runs than shown in column 2 are made, the man-hours per run may be a trifle longer, but the man-hours per mile of pipe cleaned will be less than shown in column 5.

In Table 2 are shown some man-hour figures on the laying of new mains. These were derived from information in the handbook, *Estimating Construction Costs.** There may be some question as to the assumption that a man can take out 10 yd. of sand per day from a 3-ft. trench and 9 yd. from a 5-ft. trench, and that he can backfill at the rate of 16 yd. per day. Everyone should be guided by his own experience in this respect. The author's purpose has been merely to use a recognized authority for average figures. If labor is more efficient, the labor saving will be less. On the other hand, it is seldom that conditions are so favorable as to necessitate only 3-ft. trenching in sand. The deeper the digging and the more unfavorable the soil conditions, the greater will be the difference between the labor required for laying and for cleaning mains.

The factor of paving has not been considered here, but it is obvious that the holes, 6 or 8 ft. in length at various intervals, needed for cleaning compared with the continuous open trench required for pipe laying makes the cleaning alternative very attractive.

*UNDERWOOD, G. *Estimating Construction Costs.* McGraw-Hill, New York (1930).

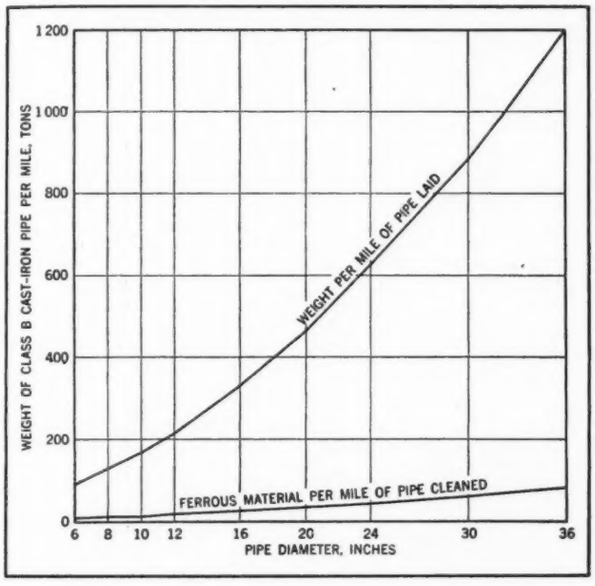


Fig. 1. Weight per Mile of Iron Required for Laying Mains Compared With Weight per Mile of Iron and Steel Used in Cleaning Mains.

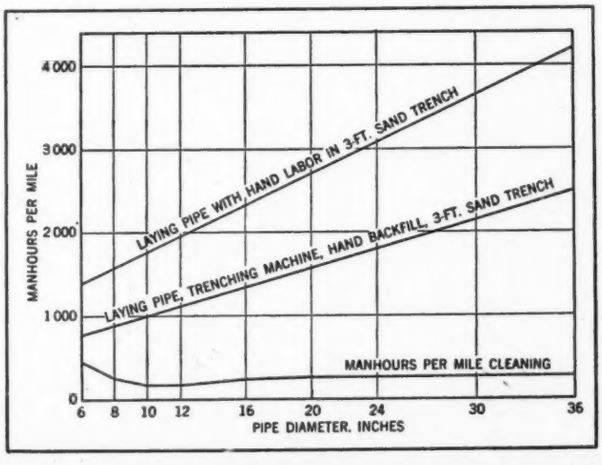

MANHOURS PER MILE
4 000
3 000
2 000
1 000
0
LAYING PIPE WITH HAND LABOR IN 3-FT. SAND TRENCH
LAYING PIPE, TRENCHING MACHINE, HAND BACKFILL, 3-FT. SAND TRENCH
MANHOURS PER MILE CLEANING
6 8 10 12 16 20 24 30 36
PIPE DIAMETER, INCHES

Fig. 2. Comparison of Manhours Required to Lay New Mains With Manhours Required to Clean Mains.

In Table 3 and Figs. 1 and 2 comparisons are made of the ferrous materials used for laying cast-iron bell and spigot Class B pipe and those consumed per mile of water main cleaned and of the man-hours required for each procedure. From this comparison it will be noted that the amount of material required in cleaning is almost negligible.

TABLE 3

Comparison of Man-hours and Ferrous Metals Required for Laying and for Cleaning Mains

Main Diam.	Laying Mains: Manhours per mi. for Hand Work in 3 ft. of sand	Laying Mains: Manhours per mi. for Trench Machine in 3 ft. of sand	Laying Mains: Ferrous Metals per mi.*	Cleaning Mains: Manhours per mi.	Cleaning Mains: Ferrous Metals per mile†
in.			lb.		
6	1,404	763	176,000	422	1,900
8	1,554	843	250,800	253	2,500
10	1,760	971	336,600	169	2,325
12	1,967	1,105	433,400	169	3,000
16	2,276	1,268	660,000	211	4,500
20	2,641	1,477	924,000	252	6,100
24	2,995	1,702	1,232,000	252	8,100
30	3,545	2,041	1,760,000	252	11,600
36	4,200	2,477	2,398,000	252	15,600

*Using class "B" pipe.

†Average for all diameters, taken over a 5-yr. period, and arrived at by taking all steel purchased and dividing by the number of miles cleaned. This covered materials per mile as follows: ⅜-in. cable, 27.14 lb.; ¼-in. cable, 0.34 lb.; ⅝-in. cable, 22.52 lb.; high grade steel, 5.5 lb.; and other steels, 42.0 lb. To this 97.50 lb. per mile has been added weight of pipe and sleeves for repairing cleaning cuts.

In all of the above figures, costs are not mentioned, but obviously the savings in dollars will be in proportion to the savings in materials and man-hours. In many instances, restoration of capacity, particularly in supply lines, has obviated the necessity for booster pumps and higher pump pressure. Friction losses mean power losses, and power costs money. The reduction of friction losses saves power—another critical product.

Taking into account the vast governmental expenditures of today, it would seem that dollars are the last consideration with "Uncle Sam." This attitude cannot, however, be subscribed to by the water works operator. Both materials and labor represent money; therefore, the savings in materials and man-hours to be achieved when the increased capacity to be obtained by cleaning will serve the purposes become a real issue in the economical operation of the plant.

Examples of Cleaning Benefits

Where pumping is necessary, reductions in friction losses by cleaning insure a reduction in power costs. A few examples will demonstrate the importance of this factor:

A 12-in. line in California, 35,338 ft. in length, was being used at greatly reduced capacity, as indicated by a Williams-Hazen coefficient of $C = 74$. Cleaning of this line raised the coefficient to $C = 121.3$. In other words, at a 2-mgd. flow, the increase in capacity represented a theoretical saving of about 95 hp.

The cleaning of an 8-in. line in a city in Texas made possible the postponement for five years of laying an additional line, thereby saving the city $1,000 per year on investment charges, or approximately five times the cost of cleaning.

A small city in Georgia reduced its pumping expense $200 per month by cleaning its supply line, out of which saving it paid for the cost of cleaning in six months.

In a small city in South Carolina, booster pumping was necessary prior to cleaning of its 12-in. raw water line. After cleaning, 30 per cent more water was delivered without the use of the booster pump. Informa-

tion regarding the actual dollar value of savings in this case is not available, but the sum was considerable.

Similarly, in one of Georgia's large cities, a program of pipe cleaning in one section of the distribution system secured an 80 per cent increase in hydrant delivery, as evidenced by fire underwriters' tests.

Other examples of the benefits of main cleaning are offered in the experiences of various Army and Navy bases throughout the country:

At the naval base at Fort Sampson, N. Y., about 100,000 ft. of 12-in. used steel pipe was laid. It was decided that this old pipe could be cleaned more rapidly and at less expense after installation. A part of this project has already been completed.

To provide adequate service for the Illinois Ordnance Plant at Marion, Ill., 18,776 ft. of 14-in. supply line was recently cleaned.

At Fort Jay, N. Y., all mains from 6 to 10 in. in diameter, both for salt and fresh water, have been cleaned. The salt water lines were thoroughly sterilized and included in the fresh water system, so that the needs of the fort could be met with a small amount of inter-connection.

Other such projects have been undertaken at Fort Slocum, N. Y., Fort Andrews, Mass., Jefferson Barracks, Mo., Fort Jackson, S. C., Newport, R. I., Naval Torpedo Station, Fort Revere, Mass., and Bedloe's Island, N. Y.

WATER AND SEWAGE PATENTS (Of Recent Issue)

By JULIAN F. SMITH
CHICAGO

Water

Water Softener. E. E. Eickmeyer and A. G. Horvath (to Dayton Pump & Mfg. Co.). U. S. 2,298,356, Oct. 13. A distributing valve for a water softening system has a rotor engaging with the distributing head, and ports in the distributing head communicating with passages in the rotor.

Silica Removal. O. Liebknecht (to Permutit Co.). U. S. 2,298,707, Oct. 13. Treating water with calcined magnesite to remove dissolved silica, and reactivating the spent reagent with acids and salts.

Water Softener. George Moore. U. S. 2,299,246, Oct. 20. A water softening system has a brine tank from which a pipe leads to a zeolite tank, with control valves for adjusting water and brine feed.

Water Cutoff. Samuel Valuch. U. S. 2,299,365, Oct. 20. Apparatus for stopping a water line during meter changes.

Electrolytic Softening. Reginald H. Crouch. U. S. 2,299,964, Oct. 27. Passing electricity, at a current density of 0.2 to 3.4 microamperes per square inch, through water to diminish the effects of hardness in the water.

Purifying Water. Earl V. Godfrey (one-half to Jos. A. Rossi). U. S. 2,300,564, Nov. 3. Sterilizing and purifying water by adding to each gallon about three drops of a ferric chloride solution which contains 3-5 per cent of free hydrochloric acid and about 32 grams of potassium chlorate.

Venturi Aspirator. G. M. Booth (to Wallace & Tiernan Co.). U. S. 2,300,642, Nov. 3. A Venturi aspirator for drawing gas into a stream of water is adjustable both by varying the throat area and by means of an adjustable member inside the tube.

Clarifying Water. R. R. Magill (to Coal Processing Corp.). U. S. 2,301,429, Nov. 10. Flocculating and precipitating suspended matter from water by treatment with a composition of powdered coal, tetrasodium pyrophosphate and ferric sulphate.

Softening Water. Adolf Richter (vested in the Alien Property Custodian). U. S. 2,301,669, Nov. 10. Passing water through successive ion exchange filters for hydrogen ion, hydroxyl ion and cation-anion exchange, the first two being regenerated at intervals by acid or alkali while the third is automatically regenerated by residual ions in the water.

Water Filter. Jas E. Michaud. U. S. 2,302,240, Nov. 17. A housing enclosing a screen and, inside the screen, a porous stone while a layer of charcoal is interposed between the screen and the housing.

Water Treatment. W. M. Bruner (to E. I. du Pont de Nemours & Co.). U. S. 2,302,598, Nov. 17. Dissolving a hydroxynitrilosulphonate in water to improve the performance of the water in flocculation, deflocculation, foaming, deterging, dyeing and wetting operations.

Sewage

Sewage Sampler. Chester F. Proudman and Henry H. Goossen (Goossen assignor to Proudman). U. S. 2,298,627, Oct. 13. A device for sampling sewage effluents has a chamber with a valve and valve port of about equal size at top and bottom, both valves being engaged by an actuating and balancing rod.

Activating Sulphur. F. R. Minger and W. L. Scoles (to Dow Chemical Co.). U. S. 2,299,917, Oct. 27. Activating finely divided sulphur compositions by adding a small proportion of partially bacteria-digested sewage sludge.

Sewage Ejector. C. Yeomans, H. Woods and H. T. Jeffery (to Yeomans Bros. Co.). U. S. 2,300,039, Oct. 27. A package type sewage ejector is installed in a closed pit completely housing a pneumatic ejector which has an airtight receiver connected by an inlet pipe to the sewage supply outside.

Dewatering Sludge. H. F. Oswald (to Oliver United Filters, Inc.). U. S. 2,300,693, Nov. 3. Dewatering biological waste sludges by adding a small amount of a chloride or sulphate of a divalent metal, then filtering the sludge.

Backwater Control. Dennis H. Anderson (to Geo. J. Dehn). U. S. 2,300,856, Nov. 3. Backwater control apparatus for sewers has a valve which prevents backflow from the sewer into outlets from buildings.

Trickle Filter. Robt. O. Friend, Wm. F. Schaller and J. A. Montgomery. U. S. 2,201,025, Nov. 3. Delivering water instantly to at least a fifth of the total area of a filter bed more than 26 ft. in diameter, by means of a stand pipe and rotating distributor.

BUBBLER FOR DETECTION OF WAR GASES

By CLIFTON BOVEE*
Research Chemist
BUREAU OF WATER WORKS AND SUPPLY
LOS ANGELES

A CIVILIAN preparedness measure of concern today is the possibility of gas attacks occurring in our cities in the event of enemy raids. To be prepared for this contingency it is necessary that civilian defense volunteers be trained in the methods of gas detection and be able to use such simple equipment as is practicable for objective chemical tests.

The problem of chemical identification of the war gases has received considerable attention since their introduction in the last war, and methods for the detection of these agents abound in the literature. At the outset it is well to note that the majority of experts in this field concede that on the whole chemical tests are not as sensitive as perception by a trained sense of smell. There are, however, a number of objections to relying implicitly on the sense of smell. Civilian volunteers drawn into this phase of activity usually have not had long and intimate experience with the agents, but are generally given sniff sets with which to familiarize themselves with simulated odors of war gases. These odors may or may not have a close resemblance to the genuine agent, but, at any rate, there is no assurance that an odor memory is developed that will function during an air raid when confusion and panic are inevitable. Further, individual variations in the sense of smell must be taken into account along with its great susceptibility to fatigue. Characteristic odors may also be deliberately masked, or unfamiliar agents may be introduced.

In the light of the above reasoning, the necessity for objective chemical methods becomes apparent for detecting the presence of gas and determining the type in order to indicate the proper medical treatment, evacuation measures, and decontamination procedures necessary.

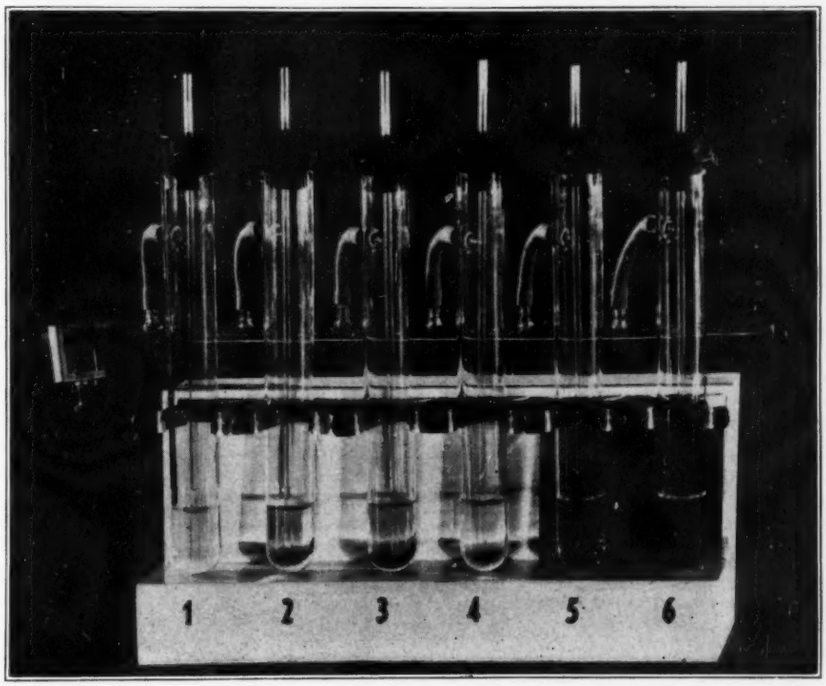
Tests for the war gases are legion, ranging from the use of simple test papers through complex laboratory procedures, and several comprehensive laboratory schemes of analysis have been evolved, such as those of Studinger[1] and the British Air Raid Precautions Department.[2]

Field tests for the war gases must be sensitive and specific, and the apparatus required must permit simple and rapid determinations to be made. For field work, the air-flow method of analysis has generally been accepted as the most logical scheme in view of the sensitivity which may be attained. Apparatus designed for field use has ranged from the simple kits of test papers and mustard gas aspirator furnished the British Gas Identification Officers[2] through nonspecific types such as the Kling Polydetector[3] and the Chema-S Detector to general types such as the Russian M-4 and recently the cumbersome Stamford, Conn., Military Police Type.[4]

A Bubbler Type Gas Detector

The bubbler type of gas detector described in this paper has been adopted as the standard field warning device by the Bureau of Water Works and Supply of Los Angeles to insure the prevention of casualties among treatment plant operators and repair crews, thereby insuring the continuous delivery of ample and safe water in times of emergency. This apparatus and the tests described are a part of the results of several years' work on the problem of war gases taken up in the Sanitary Engineering Division Laboratory with regard to the safeguarding of municipal water supplies under wartime conditions. This equipment has proven so successful that it has also been adopted as standard by the Los Angeles Citizens' Defense Council for the use of its Gas Officers to provide them with objective means of detecting and identifying war gases in the event they are used on the civilian population.

The air-flow type of analysis has been incorporated here into a multiple bubbler to obtain the advantages of speed and simplicity of operation. The reagents selected for use from the large number available are those which have best withstood comparative tests for sensitivity and given the most striking changes. The particular group chosen consists of those reagents which taken together will give the most adequate coverage of the war gases considered most likely to be used. (There are, of course, many other less effective war gases, but it is very improbable that they will ever be encountered; even



The Los Angeles War Gas Detector.
(Fifty-five having been produced at a cost of less than $5.00 each.)

* The author is Laboratory Control Gas officer, Los Angeles, Citizens Defense Corps.

so, most of them give some reaction with the bubbler.) While specificity for chemical tests embracing the determination of a number of war gases is possible, it would preclude the use of valuable general reagents and necessitate laboratory procedures not adaptable to field use, as well as sacrificing the element of speed. Therefore, a further basis for the choice of the reagents selected was the high degree of specificity they give when the individual results are considered as a unit.

The apparatus required consists of a wooden rack conveniently built from two 12-inch lengths of 2 by 4's assembled as shown and enameled white. The six bubblers are 25x200 mm. filter tubes fitted with one-hole stoppers through which lengths of 4 mm. Pyrex glass tubing extend nearly to the bottom of the tubes. These tubes are held at 2-inch intervals on the rack by No. 1 adjustable clips. The side arms are connected to a glass manifold having six 6 mm. outlets blown on a 1-foot length of 8 mm. Pyrex tubing. The manifolds can be made quite reasonably by any glass-blower, or if this is not feasible, may be constructed by coupling T-tubes with pieces of rubber tubing. A 25-foot length of tubing (preferably rubber tubing) is used to connect the manifold to the aspirator.

For civilian defense usage, the most useful aspirator is a water ejector. The ejector, screwed onto a standard hose coupling, may be quickly connected to the nearest faucet bibb or hose end, which is always near at hand in a city. Two types of ejectors, which are quite satisfactory, are the hard rubber "Emp-Fil" ejector commonly used for emptying washing machines, and the McDaniel Suction Tee with a foot of tubing fastened to the outlet. Also, excellent suction may be readily obtained at idling engine speed from the windshield wiper connection on the engine manifold of the car or truck used to reach the area. As a last resort in extreme emergencies, the end of the rubber tubing may be fitted to the intake of a gas mask canister and normal respiration of the wearer will provide adequate bubbling. Air taken in this manner is doubly purified by passing through the reagents, so no qualms need be felt for its safety.

Control of the turbulance in the bubblers is secured through an adjustable screw clamp on the short piece of rubber tubing over the open end of the manifold.

Reagents

Stock bottles of prepared reagents and distilled water are stored with the bubbler and approximately 10 ml. portions added to the respective tubes before use—see picture. How these reagents react to indicate the presence of various gases is revealed in Table I.

No. 1 — Schroeder's Gold Chloride Reagent.

Gold chloride, $AuCl_3$..... 1 gram
Concentrated hydrochloric acid ..... 1 ml.
Distilled water .....1,000 ml.

No. 2—Sodium Iodoplatinate Reagent.

(a) 1 ml. of 5% platinum chloride ($H_2PtCl_6.6H_2O$) solution is added to a little water containing 0.265 mgs. of sodium iodide. After standing 24 hours the solution is made up to 1 liter and will keep indefinitely. This solution must not give a blue color when a portion is tested with starch. If it does, air must be bubbled through for an hour or two to remove the free iodine.

(b) Starch solution, about 1%. Make up fresh occasionally by rubbing 1 gram "soluble" starch to a cream with a little water, then adding 100 ml. of boiling water.

For use pour about 10 ml. of the iodoplatinate reagent in the filter tube and add 2 to 3 drops of starch indicator.

No. 3—Potassium Permanganate Reagent.

A .002% solution of potassium permanganate acidified with a few drops of sulfuric acid.

No. 4—Methyl Orange Reagent.

Dissolve 0.5 grams of methyl orange in a liter of distilled water and store in the dark.

For use add 1 drop of the indicator

TABLE I—INDICATION OF TESTS

Reagent	No. 1 Gold Chloride	No. 2 Iodoplatinate	No. 3 Permanganate	No. 4 Methyl Orange	No. 5 Silver Nitrate	No. 6 Sodium Sulfide
Colors at start.....	Yellow	Red-brown	Pink	Yellow	Colorless	Colorless
Colors after exposure to:						
Mustard gas	Fine yellow turbidity (1)	Blue (1)	Decolorized (1)	Pink (2)	White opalescence (3)	(a) clear (b) white turb. (2)
Lewisite	.....	Bleached (1)	Decolorized (2)	Pink (1)	White turb. (2)	(a) white turb. (2) (b) white turb. (1)
Ethyldichlorarsine.		Bleached (1)	Decolorized (1)	Pink (2)	White turb. (2)	(a) white turb. (2) (b) white turb. (1)
Methyldichlorarsine		Bleached (1)	Decolorized (1)	Pink (2)	White turb. (2)	(a) white turb. (2) (b) white turb. (1)
Phosgene	.....	.....	.....	Pink (1)	White turb. (1)	.....
Diphosgene	.....	.....	.....	Pink (1)	White turb. (1)	.....
Chlorpicrine	.....	.....	.....	.....	.....	(a) yellowish (1) (b) white turb. (1)
Chloracetophenone.		.....	.....	.....	.....	(a) white flakes (3)
Brombenzyl cyanide	.....	Bleached (3)	.....	.....	Yellowish turb. (2)	.....
Diphenyl chlorarsine	.....	Bleached (1)	Decolorized (2)	Pink (3)	White opalescence (3)	.....
Diphenylamine-chlorarsine	.....	Bleached (2)	Decolorized (1)	Pink (3)	White opalescence (3)	.....
Diphenyl cyanarsine	.....	Bleached (3)	Decolorized (2)	.....	.....	.....

NOTE: Small numerals in the boxes indicate the respective reaction speed as follows: 1. Very sensitive, quick change. 2. Moderately sensitive. 3. Less sensitive—require appreciable gas concentrations or extended bubbling.

to 10 ml. of distilled water in the filter tube.

No. 5—Silver Nitrate Reagent.
Silver nitrate ..... 10 grams
Concentrated nitric acid .. 1 ml.
Water ..... 100 ml.
Protect this solution from light.

No. 6—Sodium Sulfide Reagent.
(a) Sodium sulfide—dry flakes.
(b) Sulfuric acid, 1:3.

For use add about 5 mgs. (the size of a good pinhead) to 10 ml. of distilled water in the filter tube. After suitable exposure to a suspected atmosphere, if no turbidity is already apparent, add one drop of the acid.

Sampling for Laboratory Checkup

Although the alkyl chlorarsines give the same reactions here, it is usually unnecessary to distingish between them further, since medical treatment and decontamination procedures are the same for this group.

In the event of a new or unidentifiable gas being encountered, it is imperative that a sample be collected for further laboratory analyses. This is accomplished by disconnecting the bubbler and inserting a funnel packed with silica gel into the rubber tube and allowing a considerable amount of aspiration through it. The funnel and contents are then capped or placed in an airtight container for subsequent analyses.

Gas Corps Organization

The Los Angeles Citizens' Defense Gas Corps is directed by H. A. Van Norman, General Manager and Chief Engineer, Bureau of Water Works and Supply, with R. F. Goudey, Sanitary Engineer of the Bureau, as Technical Assistant. The Corps has been organized by giving a short course of basic training to volunteers drawn largely from members of the American Chemical Society residing in this area. Fifty-five casualty stations for medical treatment and decontamination of gas casualties have been established, scattered throughout the area where school gymnasium shower facilities are available, and a trained Gas Officer is attached to each station in addition to the medical personnel. At the average cost of $4.10 per unit, 55 of these bubbler sets have been readily assembled at a total cost of $225 for materials and pumps and all reagents. One unit has been placed at each station under the charge of its Gas Officer.

At the first sign of an impending air raid, the Gas Officers are instructed to proceed to their stations and start the bubblers. In this manner an adequate over-all coverage of the metropolitan, suburban and certain vital defense industries will be assured in case gas is used. If gas is detected or suspected at certain locations, the bubbler can be rushed from the nearest station to that point for on-the-spot analysis. The unit may also be used in the examination of food, clothing, or other contaminated objects.

The laboratory of the Bureau of Water Supply is used as the control center and will perform all analyses that become necessary.

References—
1. Studinger, J. Chemistry & Industry, 15 225 (1937).
2. British Ministry of Home Security, "The Detection & Identification of War Gases." 1st Ed. Chemical Publishing Co., Inc., New York, N. Y. (1940).
3. Berthelot, C. Chimie & Industrie, 43 91 (1940).
4. Bradley, T. F., Chemical & Engineering News, 20 893 (1942).

The Flash Test in Control of Break-Point Chlorination

By *Paul C. Laux and J. B. Nickel*

The following modification of the flash color test in the control of Break-Point Chlorination is offered by Paul C. Laux, City Chemist and Supt. of Filtration at Anderson, Ind., and J. B. Nickel of the Tennessee Corp., Atlanta, Ga. This modification has been made of the original procedure in the test developed by Laux at Anderson in the early days of "Break-pointing." The authors state that the modified test offered is simpler to perform, less rigid in requirements, and more positive in results.

It was found that an orthotolidin solution of very low acid content (0.1 ml. HCl per liter), when added to the chlorinated water, produces no color of any nature until the chlorine dosage has slightly exceeded the critical break-point. When this faintly acidic solution is added to waters chlorinated beyond the break-point, it develops an instant blue or yellow color. With waters of fairly low pH, the color develops and remains blue. Waters of about pH 7.9 develop a blue color which instantly turns yellow, and in waters of still higher pH the color flashes in yellow or orange and does not change. The color intensity increases with increasing chlorine residuals.

In using the low acid solution for plant control of chlorine dosages, residual chlorine readings should be made in the usual manner. The modified orthotolidin solution should be used *only to determine whether or not break-point chlorination has been exceeded.* Sufficient time must elapse between the chlorine application and the addition of ortho-tolidine solution to permit complete reaction between the chlorine and the ammonia in the water being treated. At room temperature, a 20-min. period is sufficient; with waters near freezing, a period of 45 min. is indicated.

Numerous laboratory experiments indicate that this method is applicable to waters varying in pH from 6.2 to 9.5, regardless of the chlorine demand. Many waters used in the tests were synthetically prepared; others were natural waters collected from a variety of sources.

The Reagent

The ortho-tolidine solution used may be prepared by grinding 1 gram of ortho-tolidine powder thoroughly in a 6-in. hard glass mortar, adding 5 ml. of a previously prepared acid solution (10 ml. hydrochloric acid diluted to 100 ml.) and grinding the mixture to a thin smooth paste. This paste should then be rinsed into a 1 liter volumetric flask, the flask partially filled with distilled water, shaken thoroughly and filled to the mark.

The Procedure

To 100 ml. of the sample, measured into a flask or beaker, 1 ml. of the solution should be added and the contents of the flask swirled. If a definite color appears instantly, break-point chlorination has been attained. Otherwise, the residual chlorine is just at or below the break-point.

[Note—Experience with the low acid ortho-tolidine solution at Indianapolis reveals that a spontaneously formed blue color develops when the residual chlorine is something less than 0.5 p.p.m. above the break-point demand. At the Indianapolis plant a solution of ortho-tolidine dihydrochloride (1.34 gms. dissolved in 1 liter of distilled water) is employed in the test. No acid is added, since the dihydrochloride is highly soluble.—Ed.]

TREATMENT OF A DEFENSE PLANT WASTE

By ROLF ELIASSEN[1] AND CLAIR N. SAWYER[2]
NEW YORK UNIVERSITY
NEW YORK, N. Y.

MANUFACTURING plants requiring the use of machine tools produce a unique type of waste which creates new problems for the sanitary engineer. In the roughing and finishing of the untold millions of separate metallic parts required for the conduct of mechanical warfare, cutting oils must be used in lathes, milling machines, drill presses, shapers, grinders, and similar equipment. The wastes from these operations are composed of metallic chips and oils.

Collection of the mixture of metal and oil is readily accomplished by the installation of a suitable trough or other catching device located directly under the cutting tool. A pipe may be used to conduct the wastes to a larger separator tank in which most of the metal will settle. Some of the metallic particles are so fine that they remain in suspension and must be separated from the oil by centrifuging or filtration. Both the metal and the oil may be reclaimed for further use. No special problems arise from this procedure.

Prevalent throughout industry is the problem which is created when oil unavoidably drops to the floor under the machines. This oil forms a film which must be removed from the floor to eliminate industrial hazards and maintain cleanliness. Merely flushing the floor with a stream will not suffice to remove the oil. Experience has shown that the oil must first be released through the use of an emulsifying agent and then removed by some physical means.

Cleaning-up Operations

Certain defense plants in which the authors were engaged as consultants utilized a patented mixture containing principally tri-sodium phosphate, as well as other detergents, as emulsifying agents. These compounds are highly alkaline, relatively inexpensive, and readily available. In order to secure the maximum efficiency of oil removal from the floors, it was found expedient to make up a 2.5 per cent solution and to heat the liquid to a temperature of 200°.

Authors

Eliassen and Sawyer

Mopping provides a simple method of applying this solution to the floor. It provides friction to assist in the release of the oil after the chemical has brought about emulsification. It also furnishes a means of removing the emulsion from the floor, at the same time leaving the floor in a reasonably dry state. Production on the machines need not cease as the mopping takes place, because it is only necessary for each worker to step away from his machine momentarily. Furthermore, no complicated series of floor slopes and drainage outlets are necessary to drain off the floors after washing, as would be the case if other liquid methods were employed. Even though additional janitor personnel is required, the advantages of this method of cleaning oily floors are such that it is becoming standard practice in many industrial plants engaged in war production.

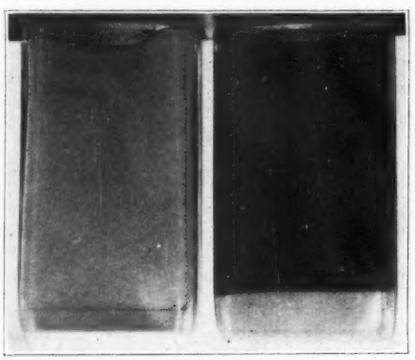


Fig. 1

Cold Flotation *Hot Flotation*

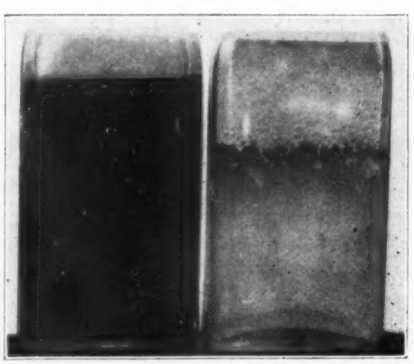


Fig. 2

Cold Flotation *Acid Treatment*

The cleaning solution is transported through each plant in 50 gallon buckets made of corrosion-resistant material. One janitor is assigned to each bucket to mop a certain area of the plant. After an hour or two of continuous mopping, the bucket will contain a slop with such a heavy emulsion of oil that the power of the cleaning solution is spent. The contents of the bucket are then ready for disposal.

The Waste Resulting

Analysis of a composite sample of the waste from the janitor's slop bucket showed it to have the following characteristics:

TABLE I

Petroleum Ether—	
Soluble matter	104,000 ppm
Total solids	120,000 ppm
Alkalinity—	
Phenolphthalein	18,000 ppm
Methyl orange	22,000 ppm
B. O. D. (5-day).....	5,000 ppm
pH	12.0

The high oil and grease content, together with the strong B.O.D., indicate that this waste should not be disposed of by discharge into a river or municipal sewer without treatment for grease removal.

A Study of Methods of Treatment

Numerous experiments were conducted in the Sanitary Engineering Research Laboratory of New York University in an effort to determine possible methods of treatment. It is obvious that the major problem is the separation of oil from the water. The only way to accomplish this is to break the emulsion holding the oil in suspension. In these critical times,

[1]Associate Professor of Sanitary Engineering.
[2]Assistant Professor of Sanitary Chemistry.
[Note: Since the work reported in this paper was done both authors have entered the armed services of the nation. —Ed.]

industrial concerns are not willing to expend money and materials on elaborate types of treatment. Hence, simplicity and economy were primary considerations in this investigation.

Reduction of temperature was the first step to be accomplished in treatment. Upon standing until the temperature of the slop is reduced from 200° F. to 120° F., an oily scum forms on the surface. This occupies approximately 7 per cent of the original volume of the waste. A distinct line of separation occurs between the scum and the remaining liquor. This is indicated in the right-hand bottle of Fig. 1. Analysis of the underflow liquor shows it to still contain 10,000 p.p.m. of petroleum ether soluble matter. Thus, considerable oil remains emulsified in the aqueous layer, which is indicated by the turbid appearance of the liquor. It is evident, therefore, that adequate treatment has not been accomplished. By further reducing the temperature of the slop to 80° F., a rapid and complete separation takes place. The oil appears to become trapped in floc particles of appreciable size. These floc particles were observed to have a rising velocity of 5 feet per hour, equivalent to an overflow rate of 900 gallons per square foot per day. Upon standing until the underflow is clear the floc will gather into a blanket of scum which will occupy about 13 per cent of the original volume of liquor. This may be seen in the left-hand bottle of Fig. 1. Analysis of this scum shows that it contains 53.7 per cent petroleum ether soluble matter, the greater portion of which is oil.

The resulting underflow liquor is brown in color, but it is clear, free from suspended solids and turbidity. The following analysis was obtained on a representative sample:

TABLE II

Petroleum Ether—	
Soluble matter	264 ppm
Total solids	25,000 ppm
Alkalinity—	
Phen.	18,000 ppm
M. O.	22,000 ppm
B. O. D.	1,700 ppm
pH	12.0

This great reduction in oil content is accomplished by the combined processes of cooling and flotation.

Acidulation

The high alkalinity and pH of the brown underflow liquor, as indicated in Table II, suggest the addition of acid for further treatment before disposal to the sewer. In the process of neutralization a heavy floc forms and rises to the surface. The amounts of sulfuric acid required to reach certain pH values, as well as observations on the nature of the floc formed, are noted in Table III.

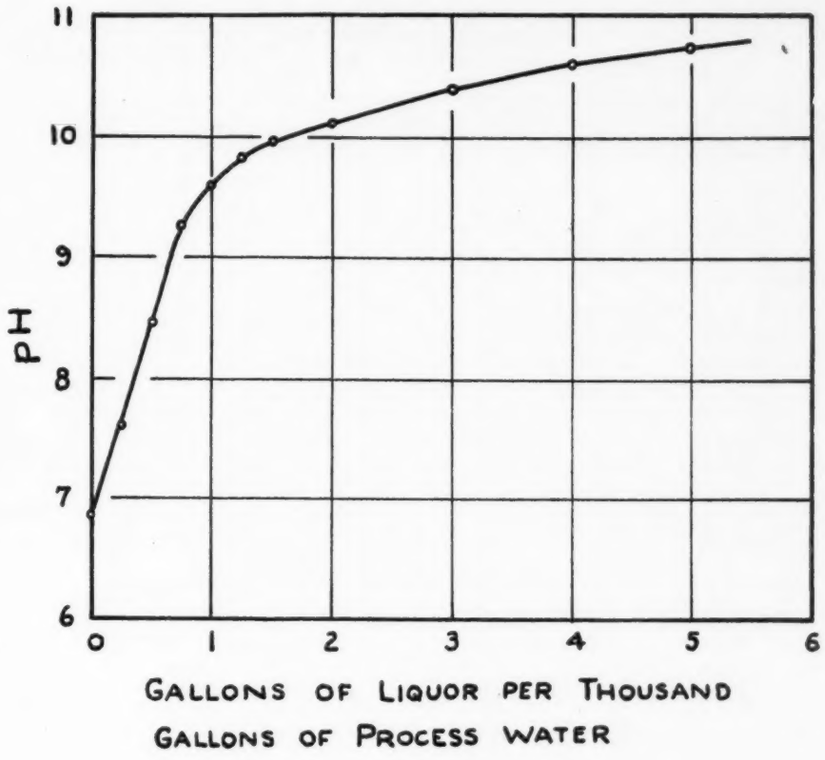


Fig. 3
Effect of Mixing Brown Underflow Liquor with Process Water

TABLE III

pH	Acid Added H_2SO_4 p.p.m.	Per Cent by Wt. of Liquor	Observations on Floc Characteristics
12.0	0	0	Clear brown liquor
11.0	11,800	1.18	Floc forms but redissolves
10.0	14,200	1.42	Liquid shows trace of cloudiness
9.0	16,300	1.63	Liquid very cloudy
8.0	17,400	1.74	Small floc particles form
7.0	18,000	1.80	Coagulation of floc begins
6.0	19,700	1.97	Heavy coagulation of floc
5.0	20,300	2.03	Heavy coagulation of floc
4.0	20,900	2.09	Floc becomes finer
3.0	22,000	2.20	Floc begins to redissolve

It is evident that when acid is added to the brown subliquor, an amphoteric substance is formed as the precipitate, since it is soluble at both high and low pH values. As far as coagulation is concerned, the optimum range of pH, or isoelectric point, lies between 5.0 and 6.0. Above or below these values, the floc either redissolves or will not be large enough to rise at a reasonable rate. In order to lower the pH to 6.0 it would require 19,700 p.p.m., or 1.97 per cent of sulfuric acid, a very high dose in any sense of the word, far higher than dosages generally considered feasible.

At a pH of 6.0 the dense floc will rise to the surface with a velocity of about 4 feet per hour, equivalent to an overflow rate of 720 gallons per square foot per day. This floc is illustrated in the right-hand bottle of Fig. 2. The left-hand bottle contains the brown overflow liquor from the cold flotation process. The comparative volumes of floating matter may readily be seen. In the brown liquor this amounts to 13 per cent of the original volume, while in the case of acid treatment the floating matter amounts to 35 per cent of the original volume.

The underflow liquor from acid treatment is clear and practically colorless, with the following analysis:

TABLE IV

Petroleum Ether—	
Soluble matter	42 ppm
Total solids	32,000 ppm
Alkalinity (M.O.)	2,000 ppm
B. O. D.	274 ppm
pH	6.0

It will be noted that the reductions in grease content and B.O.D. are very high as a result of this treatment. The pH and alkalinity have been decreased appreciably by the

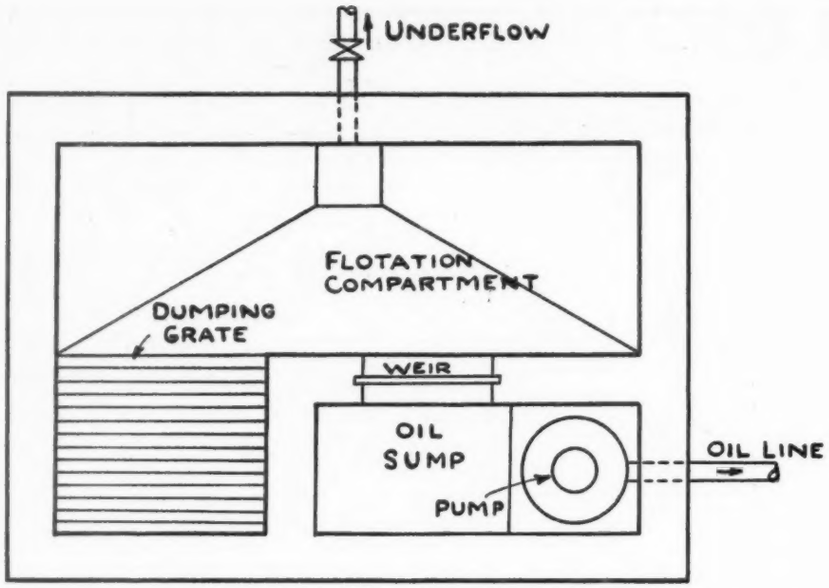


Fig. 4
Retention and Separation Tank

addition of acid but the total solids have been increased. However, the high cost of acid required to treat large quantities of this waste, together with the great volume of sludge (scum) produced, render this process uneconomical for large scale use.

Comparative removals obtained by each treatment process are presented in Table V. It will be noted that the removal of petroleum ether soluble matter, such as oils, greases and other substances, is greater than 99 per cent by the process of cold flotation alone. Wherever possible, this process should be used, providing that the effluent, with its high alkalinity, pH, and B.O.D. (see Table II), can be disposed of without serious difficulty.

TABLE V

Analysis	Per Cent Cold Flotation	Removals Acid Treatment
Petroleum Ether—		
Soluble matter....	99.75	99.96
B. O. D.....	66.0	94.5

In order to determine the effect of mixing the clear brown underflow liquor with the remainder of the liquid waste from a manufacturing plant, it would be necessary to perform titration experiments. These could be accomplished by the addition of measured quantities of brown liquor to a fixed quantity of general plant waste. Experiments of this nature were performed on the process water at the defense plant at which this problem arose. The water with which the liquor was intended to mix was a surface water supply with an alkalinity of about 100 p.p.m. and a pH of 6.85. The results of adding brown liquor, having characteristics indicated in Table II, to this process water were as indicated in Figure 3. It will be noted that the addition of as little as 0.25 gallons of waste into 1,000 gallons of process water (an addition of 0.025 per cent only) will raise the pH appreciably. In this particular case, the further treatment of the process water was adversely affected by a rise in pH. Therefore, the highly alkaline brown liquor could not be added to process water until each had undergone separate treatment and the effluents were ready for discharge into the sewer.

Suggested Practice

Treatment by the cold flotation process may be accomplished by installing a retention tank at each station where the janitors dump their slop buckets. These tanks should have a capacity equivalent to a detention period of four hours to permit cooling and flotation. To hasten the separation of oil from the brown underflow liquor it would be possible to install cooling coils in the retention tank. For each 100 gallons of slop to be cooled from 150° F. to 80° F., in four hours, it would take approximately 15,000 B.T.U. per hour. This would be equivalent to the output of a 1.3 ton refrigeration machine.

Provision should be made for the removal of oil from the surface of the retention tank. This could be accomplished by means of a skimming weir leading to an oil sump, from which it could be pumped to a disposal point. A simple and practical design for this retention tank is shown in Fig. 4. The skimmings from this tank would contain over 50 per cent of oil and should have sufficient market value to pay for hauling it away from the plant, or perhaps yield a slight return.

After the oil-bearing matter has been skimmed off the retention tank, the brown underflow liquor should be pumped or flow by gravity to the municipal sewer. Mixing with other plant wastes should not be practiced before separate treatment has been accomplished, unless the high alkalinity is needed to neutralize excessive acidity in the other plant wastes. The mixing of this alkaline brown liquor with domestic sewage in a municipal trunk sewer will not cause any difficulties inasmuch as the floc which might form as a result of any lowering of the pH would be so light that it would not settle at the velocities prevailing in trunk sewers.

The quantity of this waste will be reasonably low, in the range between 1,000 and 10,000 gallons per day for good-sized industrial plants, depending on the nature of operations and the number of machines. Owing to the nature of the work on which the defense plants mentioned in this article were engaged, further details on quantities of flow, with their relation to production and floor area cannot be given. Suffice it to say that the treatment devised for this waste will produce an effluent with an equivalent B.O.D. loading of 83 persons per 1,000 gallons. This, together with a grease content of 264 p.p.m., makes the effluent no worse than that from an average laundry, of which there will be many on a large municipal sewer.

In the treatment of this complex industrial waste, the basic methods of sanitary engineering practice can readily be employed, subject to some modifications to take into account the properties of the waste. Further treatment can be accomplised at considerable cost and difficulties encountered in sludge disposal. The economics of industrial waste treatment call for the production of an effluent which will not cause damage to or hazards in municipal sewers, or undue loads on treatment plants. In this particular case, 99.7 per cent of the objectionable grease and oil was removed by cooling and flotation to produce an effluent which could be discharged without detrimental effect into the municipal sewer system.

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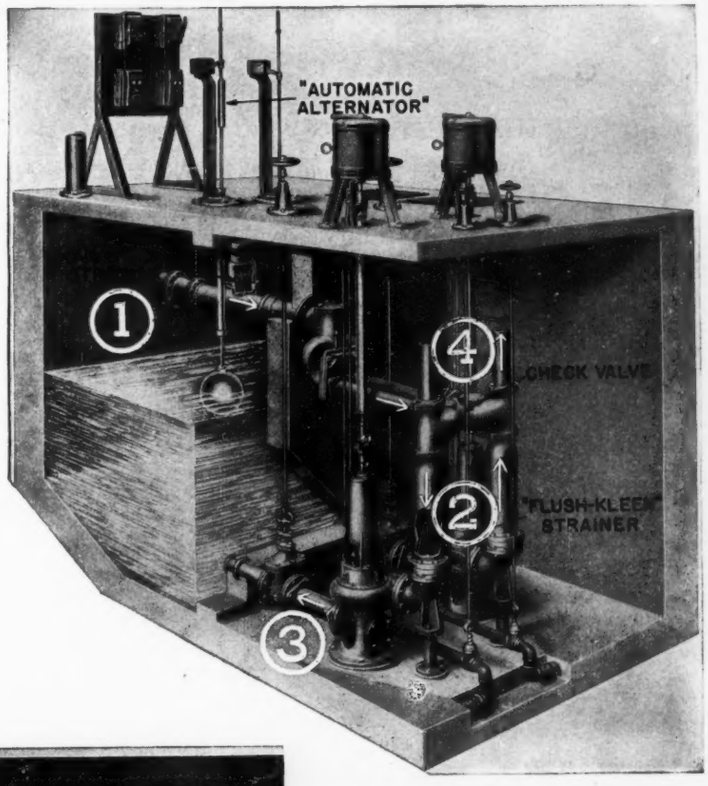
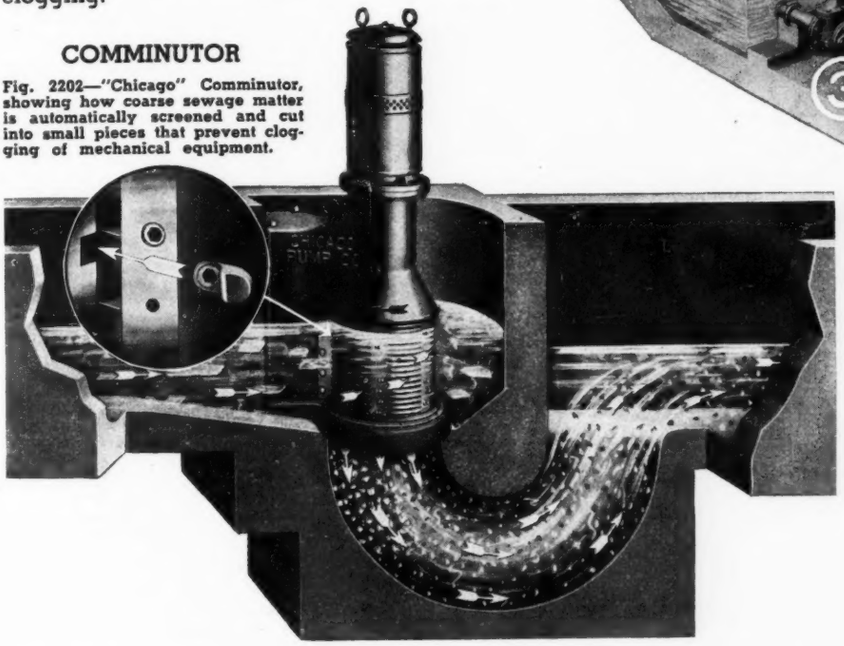


COMMINUTOR

Fig. 2202—"Chicago" Comminutor, showing how coarse sewage matter is automatically screened and cut into small pieces that prevent clogging of mechanical equipment.



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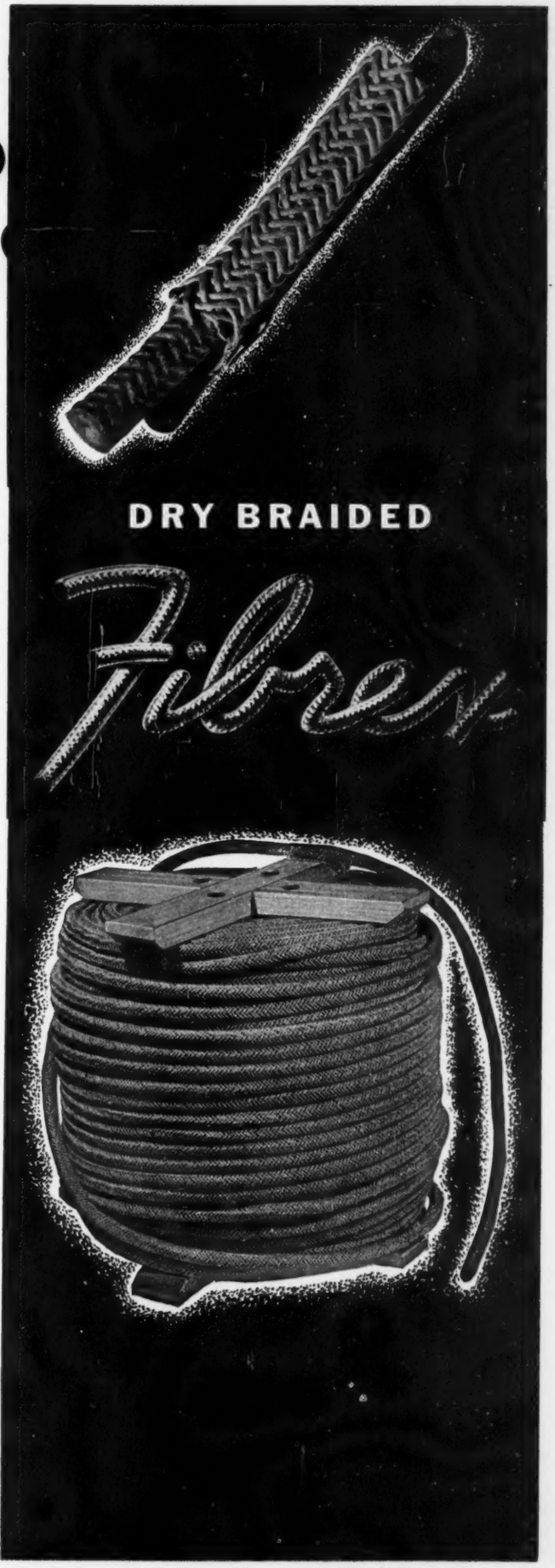

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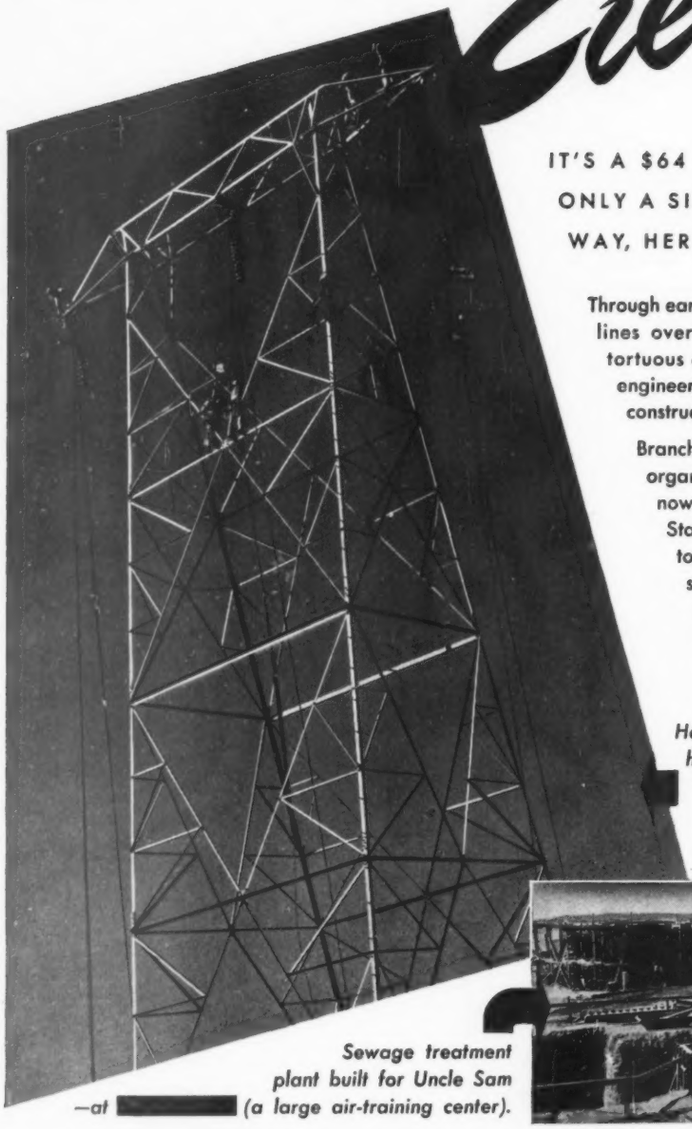

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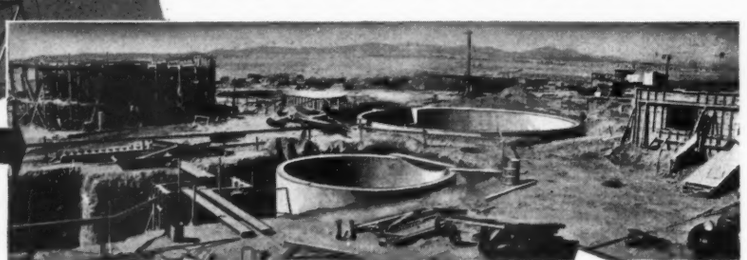

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BENTONITE AS A COAGULANT FOR SEWAGES AND INDUSTRIAL WASTES

By H. L. OLIN, RICHARD J. BOX
and R. E. WHITSON
Department of Chemical Engineering
UNIVERSITY OF IOWA, IOWA CITY, IOWA

IN an earlier paper published in WATER WORKS AND SEWERAGE, we discussed the properties of bentonite clay as a coagulant of emulsions and colloidal suspensions and reported the results of limited studies on the purification of the sewage of Iowa City, a non-industrial city of about 20,000 population. The samples involved, however, were collected in the early spring when melting snows and storm water carrying more or less street wash diluted the sewage proper to produce an effluent relatively high in turbidity but low in dissolved solids. Since chemical coagulants in general act upon suspended matter only our results showed in some cases remarkably high purification percentages, values not typical of average conditions.

In the present series of tests of effluents from the same source, a wide seasonal spread was applied to the collection of samples and except for the summer months when the work was interrupted, they cover the annual range of variation in quality. Gathering of test material was done at the inlet to the primary clarifiers of the Iowa City disposal plant after the flow had passed the coarse screens and the grit chamber, and the laboratory tests for alkalinity, turbidity, total solids, 5 day biological oxygen demand (B.O.D.) and pH were started immediately thereafter. Table I gives the dates of collection and the results of physical and chemical tests.

TABLE I
Physical and Chemical Properties of Iowa City Sewage

Sample Number	Time of Year Collected	pH	Alkalinity p.p.m.	Turbidity p.p.m.	Total Solids p.p.m.	B. O. D. p.p.m.
1.....	Feb. 10	7.2	125	268	670	136
2.....	Feb. 15	7.6	208	512	1,660	395
3.....	Feb. 24	7.5	240	630	1,380	513
4.....	Feb. 25	7.7	212	570	1,160	371
5.....	Mar. 10	7.2	272	530	1,090	414
6.....	Mar. 11	7.3	235	730	1,560	430
7.....	Apr. 7	7.6	236	300	1,140	380
8.....	Nov. 22	7.5	445	268	1,440	707
9.....	Nov. 24	7.2	422	206	912	218
10.....	Nov. 26	7.5	470	328	1,299	533
11.....	Nov. 27	7.5	456	280	950	350
12.....	Nov. 29	6.9	472	364	2,883	552
13.....	Dec. 2	..	240	620	1,333	330
14.....	Dec. 3	..	412	360	1,283	422
Average		7.4	317	426	1,340	411

Test Procedure and Findings

Dosage of each sample involved its division into eight one-liter parts which were transferred to standard Imhoff cones and treated with a bentonite suspension to bring the clay concentrations within the range of 80 to 200 p.p.m. One fraction of each was left untreated for control. No lime of other electrolyte was added since previous experience had shown that the high alkalinities of the raw sewage (125 to 472 p.p.m.) were ample to bring about prompt coagulation. In Figure 1 are plotted average sedimentation rates for the 14 samples with varying bentonite dosages.

It is seen that with bentonite additions of 80 p.p.m. or less the bulk of the sludge had settled within 10 minutes and that from that time on its volume diminished through a definite packing effect and consolidation.

From the supernatant liquid samples were siphoned off for test. Because of the voluminous data involved (5 tests being made on each of the 8 fractions of each of the 14 samples) results as shown in Table II are for the extreme and the average values of the 14 samples only.

TABLE II
Summary of Results of Coagulation Tests (14 Samples)

			Bentonite Dosages in p.p.m.						
B. O. D. p.p.m.—	Raw	Settled	50	60	70	80	100	150	200
Maximum	707	420	281	267	244	237	220	195	184
Minimum	136	113	64	58	57	52	51	48	45
Average	411	224	145	137	133	126	121	111	105
Per cent reduction, corrected*.....	....	45.5	62.0	63.7	64.3	65.4	65.6	65.5	65.4
Turbidity, p.p.m.—									
Maximum	730	296	152	134	90	77	70	43	43
Minimum	206	86	54	43	37	34	33	22	17
Average	426	197	78	65	56	48	41	31	26
Per cent reduction, corrected*.....	....	53.7	79.2	81.7	83.4	84.7	85.4	85.2	83.9
Total solids—									
Maximum	2,880	2,560	2,460	2,460	2,450	2,460	2,470	2,440	2,390
Minimum	670	570	520	530	550	550	540	510	490
Average	1,340	1,030	970	945	950	940	950	910	880
Per cent reduction, corrected*.....	....	23	25.5	26.0	25.5	26.0	24.0	24.5	26.0
Alkalinity, p.p.m.—									
Maximum	472	476	460	456	422	444	440	424	408
Minimum	125	121	127	125	125	120	121	119	121
Average	317	309	301	300	295	297	292	288	283
Per cent reduction, corrected*.....	....	2.5	2.5	2.4	3.4	2.3	2.9	1.7	0.7

*To promote accuracy in dosage extremely dilute stock suspensions of bentonite were used (2 g. per liter); corrections are made for the purification of effect which should be credited to dilution in dosing.

Especially noteworthy are the high reductions in B.O.D. at low dosages, indicating an optimum treatment at about 80 p.p.m. High reductions in turbidity were likewise obtained, pointing to almost complete removal of suspended matter, while total solids remained high.

Alkalinities are practically unchanged, as might be expected, since the bentonites are without chemical activity except for slight zeolitic action. No definite data are available on the effect of the presence of the highly hydrated clay on the biological process of digestion, although work in this phase is under way, but there is some evidence to indicate that it may be accelerated. Significant also is the observation that while bentonite coagulation reduces the biological oxygen demand 20 per cent below that effected by sedimentation alone, total solids are reduced only 3 per cent or less, showing the limitations of the total solids test in measuring degrees of purification.

In a direct comparison of extent of purification possible with bentonite treatment and that secured in the normal operation of the Iowa City disposal plant, which is provided with primary clarifiers, a trickling filter system and sludge digesters, samples of the primary influent, the clarifier effluent and the filter effluent were collected for analysis. Parallel samples of each were treated with 70 p.p.m. of bentonite and settled for two hours; results of B.O.D. determinations made on each are shown in Table III.

TABLE III
Comparison of B.O.D. Results—Disposal Plant vs. Bentonite
(B. O. D. in p.p.m.)

Time Collected	Primary Influent	Clarifier Effluent	Trickling Filter Effluent	Bentonite Treated
10:30 A. M.	763	447	166	232
1:30 P. M.	818	440	135	243
5:00 P. M.	479	358	178	138
9:30 P. M.	576	286	134	146
11:30 P. M.	346	214	77	110
3:00 A. M.	166	165	61	89
9:45 A. M.	754	323	126	194
Average	557	319	125	165
Average per cent purification (corrected)	...	42.7	77.6	67.

Note: Samples of final clarifier (humus tank) effluent revealed B. O. D. values of 50 to 70, representing an overall plant reduction of 90 per cent as compared to 67 per cent atttained with Bentonite.

As in the preceding work the overall reduction with bentonite was better than 65 per cent or only 10 per cent less than that obtained with the use of the trickling filter. It should be observed, however, that much of the residual organic matter leaving the trickling filter is in the form of flocs that settle readily and that from the humus tank beyond the filter flowed an effluent with a B.O.D. ranging from 50 to 70, representing an overall purification of over 90 per cent.

Tests on Cedar Rapids Sewage

A single sample of sewage from the system at Cedar Rapids, an industrial city with a population of 65,000 that supports a number of

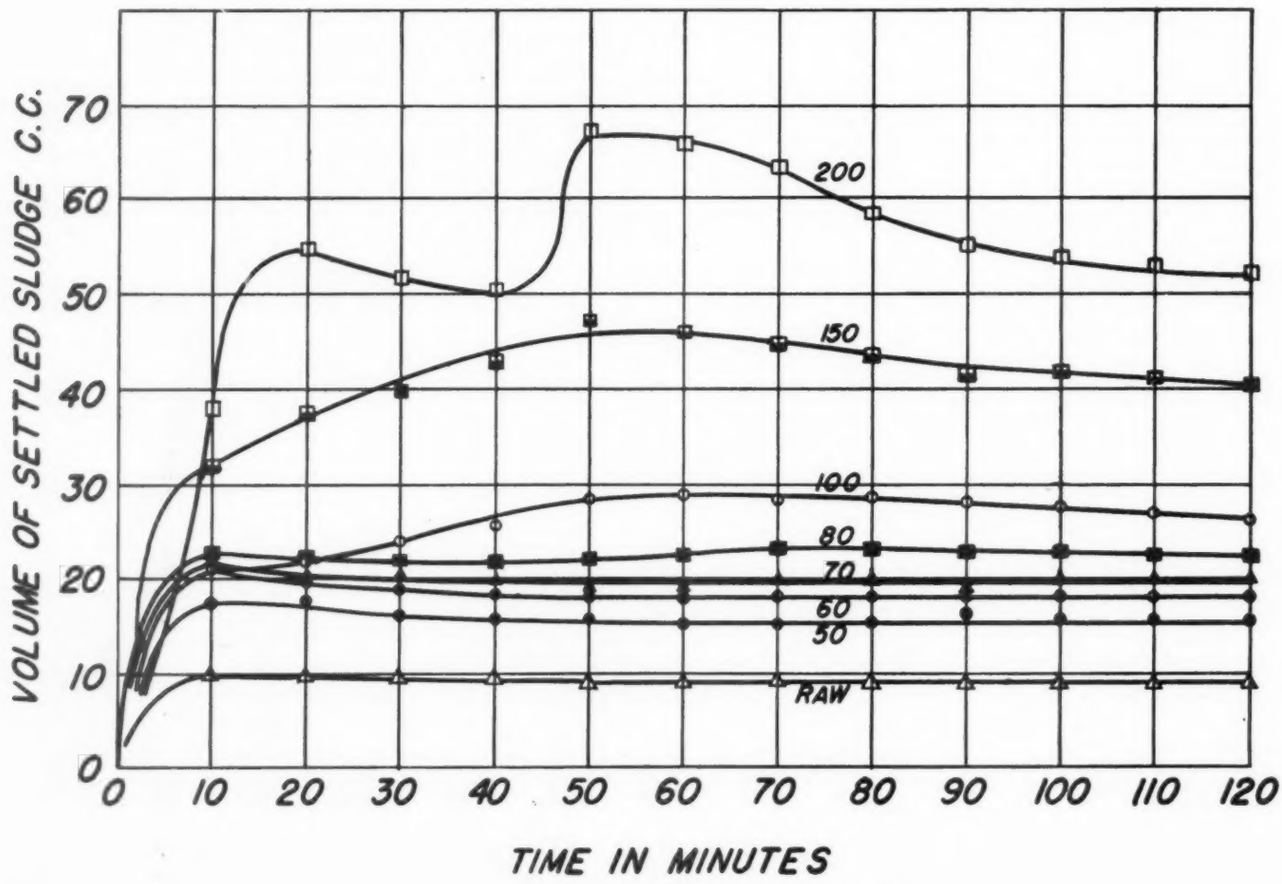


Fig. 1—Settling Characteristics of Bentonite Sludges

large cereal processing plants and a meat packing establishment, was tested as described for the Iowa City sewage, with the results shown in Table IV.

TABLE IV
Bentonite Treatment of Cedar Rapids Sewage

Bentonite p.p.m.	Alkalinity p.p.m.	Turbidity p.p.m.	Total Solids p.p.m.	B. O. D. p.p.m.	Per Cent Reduction (B. O. D.)
Raw	217	410	2,610	995	...
Settled	215	364	2,430	744	25.0
50	213	130	2,340	526 (?)	...
60	220	107	2,340	584	41.0
70	219	95	2,300	578	41.7
80	214	86	2,280	561	43.4
100	222	78	2,260	561	43.4
150	218	58	2,230	385	61.0
200	221	53	2,230	385	61.0

It is immediately obvious from the total solids value and the ratio of total solids to turbidity (6.4 as compared with 3.1 for the Iowa City sewage) that this effluent is high in dissolved solids and therefore unpromising for treatment with chemical coagulants. A reduction of 79 per cent in turbidity is normal and satisfactory but a residual B.O.D. of 500 or more places it beyond the pale of simple chemical coagulation alone. With bentonite dosages of 60 p.p.m.or more, suspended solids had settled out well within one hour's time.

Experiments with Packing-house Waste

In order to investigate the possibilities of improving a heavily laden trade waste, a sample of the effluent from the Wilson Packing Company's plant at Cedar Rapids was put through coagulation and sedimentation tests with the results shown in Table V.

TABLE V
Bentonite Treatment of Packing-house Waste

Bentonite Dosage (p.p.m.)	Turbidity (p.p.m.)	Turbidity Reduction (per cent)	Total Solids (p.p.m.)	B. O. D. (p.p.m.)	B. O. D. Reduction (per cent)
Raw	1,200	..	4,070	1,315	..
Settled	580	51	3,470	851	35
50	500	58	3,370	757	43
60	500	58	3,390	705	46
70	500	58	3,310	607	54
80	500	58	3,300	596	56
100	400	67	3,260	547	59
150	360	70	3,140	490	62
200	170	86	3,090	438	67

Precipitation so far as it went was complete in 40 minutes or less but relatively high dosages were required for the maximum effects of 86 per cent reduction in turbidity and 67 per cent in B.O.D. Again it was obvious that much of the active organic material was in solution and therefore beyond the reach of precipitation methods for removal. However, while the alkalinity was fairly high, a moderate lime dosage would have improved the effluent in both turbidity and biological oxygen demand. In his recent book on industrial wastes Eldridge[2] in discussing packinghouse effluents states that "biological processes are more easily upset by careless treatment or large variations in waste content than are chemical processes. Considering all factors involved it appears that . . . the superchlorination method, followed by chemical flocculation is superior to biological treatment." Our studies did not, of course, embrace the first stage of this suggested procedure.

Tannery and Dairy Wastes

Results of brief studies on two tannery wastes carrying 3,500 and 10,000 p.p.m. of total solids and treated with 70 p.p.m. of bentonite, were of interest, aside from turbidity and B. O. D. reductions of 95 and 66 per cent respectively, because coagulation was effected at pH values of approximately 5.0, a striking example of the versatility of this agent which is active deep in the acid range. Similar work on dairy wastes consisting mainly of dilute milk solutions which were treated with 75 p.p.m. of bentonite resulted in B.O.D. reductions of 50 per cent and almost complete removal of turbidity, i. e., the milk emulsion was entirely broken down. A new process for purifying dairy wastes recently announced by Mallory[3] employs preliminary aeration in the presence of previously oxidized (activiated ?) sludge which is followed by chemical precipitation. In a large dairy waste disposal plant in Michigan B.O.D. values are being reduced in this way from 3,000 p.p.m to 10 p.p.m., a 99.8 per cent elimination. It is of course obvious that soluble organics are being oxidized through biological action.

Studies of Pea Canning Wastes

During the pea canning season of late June, 1939, studies were carried out under the auspices of the Department by Mr. R. E. Whitson on both laboratory and plant scales to determine the possibility of improving the clarifier effluents at the municipal disposal at Vinton, Iowa, a town of 4,000 population and seat of a large vegetable cannery.

Wastes from the pea canning operation continued to have three sources: the highly concentrated effluents from the blanching machine in which the peas are flushed with water at 180°F.; the turbid water from the tube conveyor, and the flushing water used in clean-up operations. These wastes are all discharged into a pit at the plant, passed through an 8-mesh screen and then discharged into the sewer. These pea-green waters, high in soluble and putrescible organic matter and with variable biological oxygen demands, often running into the thousands, throw a heavy seasonal burden upon the disposal plant, which is provided with primary and secondary clarifiers but is without means for biological purification of the effluents. In any case disposal of seasonal waste with the biological filter would be limited by the appreciable time required to develop the filter bacteria colony to maximum effectiveness and this time lag must obviously be provided for in planning a campaign.

Results of laboratory tests with the use of bentonite on the pit wastes proved negative; the high content of solubles was of course little affected but, in addition, coagulation of collodial matter was likewise unsatisfactory. It seems clear to us from evidence based on studies of water supplies contaminated with leaf mold drainage that the vegetable extracts liberated in the blanching process (chlorophyll among others) served as protective colloids to inhibit the clotting of the clay, a phenomenon common to the use of other coagulants such as alum, as well. Scattered results of work on pea wastes[4], however, indicate that with extremely heavy dosages of lime and alum (or iron sulfate) of the order of 50 and 20 g.p.g. respectively, (856 and 342 p.p.m.) B.O.D. reductions around 40 per cent may be obtained. A 75 per cent reduction as shown by

the B.O.D. determination secured with 15 g.p.g. of zinc chloride was probably due to the toxicity of the added salt rather than to its coagulative effect. The complexity of a problem of this kind, however, is indicated by the comparative results obtained in attempts to purify beet wastes as reported by Eldridge[4] in which 56 g.p.g of lime and 28 of alum reduced the B.O.D. only 36 per cent while the use of the lime along brought it down 43 per cent.

Plant Scale Tests

In our first attempts to apply bentonite treatment to sewages on the full plant scale, brief runs were made on both "normal" flows, those coming in during temporary interruption of work at the cannery and on those contaminated with pit wastes. It should be noted in passing, however, that in addition to the cannery a poultry dressing house and a creamery were in active operation and were discharging wastes into the sewer system and that even in the runs on the so-called normal sewage it appeared difficult or impossible to exclude or eliminate completely the protective colloids coming from the pea blanching waters.

Lime and bentonite were added to the incoming stream by means of dry-feed machines. Lime sufficient to provide a dosage of 90 p.p.m. was added to a small recirculated stream and discharged into the quick-mixer tank as a slurry; the bentonite suspension which required more agitation for proper dispersion was added after passing it through a small high-speed centrifugal pump. Because of the high variation in daily rate of flow (from 100,000 to 206,000 gallons per day) and in the volume of settleable solids (from 25 cc to 8 cc per liter), valid comparisons were virtually impossible to make in the short time available for study and the results obtained are only roughly indicative of what might be accomplished.

In test runs on the normal sewage flowing at a 165,000 gallon rate with lime dosages of 100 p.p.m. and bentonite from 80 to 105 p.p.m., the B.O.D. values of the clarifier effluent were reduced 45 to 68 per cent below those of the raw feed. On the other hand, in control runs with no chemical treatment at all the effluent showed reductions of 35 to 40 per cent, with variables lying in the amount and nature of the suspended solids and of the solubles. Results of runs on sewages containing pit wastes were quite as negative as the laboratory tests on this material would indicate. Wastes of this kind belong to a class definitely not amenable to treatment with bentonite or other coagulants except under special conditions and in the measure they are present in domestic or other sewages their inhibitive effect becomes evident.

Summary

To summarize, in the most common cases where wastes are in the form of emulsions or collodial suspensions unpeptized by tannins or other protective colloids, bentonite provides a rapid and effective means for precipitating them and thereby, for improving turbidity and B.O.D. conditions of the effluents. Both in the quantity of treating agent required and in the degree of purification effected it compares favorably with the coagulants long used in industrial and sanitary processes. It excels in one particular: marked activity over a wide range of pH values.

References

(1) H. L. Olin, Chas. L. Campbell and J. V. Gauler. Water Works and Sewerage, 84, 291 (1937)
(2) E. F. Eldridge. Industrial Waste Treatment Practice, p. 272. McGraw-Hill, 1942.
(3) Idem. p. 142.
(4) Idem. Table 38, p. 165.

Editor of W. W. & S. and President of Sewage Federation Become W.P.B. Consultants

Our editor, Linn H. Enslow, and George J. Schroepfer, Chief Engineer, Minneapolis-St. Paul Sanitary District and President of the Sewage Works Federation, have recently been appointed Special Consultants to the Governmental Requirements Branch of the War Production Board.

Messrs. Enslow and Schroepfer are advising W.P.B. in respect to sewerage requirements and the production of a new P46 order especially written for maintenance and operation of sewer systems, pumping stations and treatment works handling domestic sewages and/or industrial wastes. The proposed order is to be known as P46-S and will be shorn of many complications which the present P-46 Order embraces but do not apply to sewage practices.

The survey made by the Sewage Federation has been extremely valuable in setting up allocations of materials for the sewerage field.

Edward P. Hyland Passes

"Ed." Hyland

Just as we are going to press word has reached us of the sudden passing of Edward P. Hyland, Superintendent of Water and Sewerage, Moorestown, N. J.

"Ed" Hyland, as he was fondly known by the many who admired his sterling character and conscientious leadership in the water and sewage works profession, had long been a shining light in association activities in his state. He was an active member of the American Water Works Association, a past-president of the New Jersey Sewage Works Assn., the N. J. Water Works Assn. and the South Jersey Superintendents' Assn.

He took pride in being a small town operator, and "Ed." Hyland always had his "feet on the ground" when it came to deliberations and actions taken in the associations which looked to him for that sort of moderation and guidance. He appreciated quality—in men, machinery and methods.

We are sorry that we haven't more of his background at this writing, but we can say that—As a man, a public servant and a leader, they never made them any finer than "Ed." Hyland.

A.W.W.A. Sets Dates for 1943 Conference

To be known as the "Conference on War-Winning Water Works Operations," the 1943 Annual Meeting of the American Water Works Assn. has been scheduled for June 14-17 in Cleveland, Ohio. The Carter and the Statler have been engaged as co-headquarters hotels.

The Convention Management Committee is made up of the following personnel:

Wm. J. Orchard,
Chairman

Abel Wolman	D. F. McAfee
Harry Jordan	Clinton Inglee
Reeves Newsom	C. A. McGinnis
Linn Enslow	G. W. Hamlin

Arthur T. Clark

DATING THE ICE AGE VARVES

By HALBERT P. GILLETTE

IN 1937 I published evidence of a series of weather and climatic cycles, each of which is three times as long as the next shorter one. This may be called a triple-progression series. The amplitudes of these cycles are greater than those of any other cycles of comparable length, and the amplitude increases with the length of the cycle. By means of varves (annually deposited layers of sediment) I have determined the length of the 67-year cycle of this series with great precision. It is exactly 67 years long between its peaks of rainfall, and is therefore harmonic with the earth's orbital period of 12 months. The following are the lengths in years of some of the cycles of this triple-progression series: 67/81, 67/27, 67/9, 67/3, 67, 201, 603, 1809, 5427, 16,281 and 48,843 years. The last named cycle is the Ice Age Cycle. The last "peak" (maximum snowfall and minimum temperature) of this cycle was in 27,864 B.C.

It may seem fantastic to give the date of this peak with such precision, but since the peak dates of short cycles of this series are determinable with precision, it follows that, because these cycles are harmonic, peak dates of the longest cycles are determinable with precision once their dates are determined approximately.

The 5427-year cycle had its last wet, cold peak about 700 B.C. But since the last 201-year cycle had its peak in 1883, it follows that the cycle of 27 × 201 or 5427 years must have had its peak in 729 B.C. Having established this peak date, it follows that, by a similar process, the exact peak year of the Ice Age Cycle of 9 × 5427 or 48,843 years is determinable with exactitude if the approximate date of its last dry, warm maximum is determinable at all. There is abundant evidence of a long and exceedingly dry, warm phase about 3400 B.C. This was certainly not due to the 5427-year cycle alone, for its next dry, warm peak will be in 1984; and while there is much evidence of growing warmth and dryness, it is not comparable in severity to that about 5427 years earlier. The cycle of 3 × 5427 or 16,281 years must therefore have been partly responsible for the dry, warm phase about 3400 B.C.; but the question remains whether the cycle of 3 × 16,281 or 48,843 years was not mainly responsible for that dry, warm epoch. If it was, then the wet, cold peak of that cycle (the Ice Age Cycle) was in the year 27,864 B.C.

Dr. Ernst Antevs has written two books and two long monographs, in which he graphed the thickness of several long series of Ice Age varves of New England and Canada. By measuring, tabulating and analyzing these thicknesses I was able to find several short cycles of my triple-progression series in all of these Antevs' varves.

I had found that all the large planets cause rainfall cycle peaks when they are in heliocentric longitude 288 degrees. The earth is in that longitude July 12, and it then causes a great sunspot peak, and, in many regions, a rainfall peak. Daily sunspot numbers and daily rainfall records must be used not only to establish this peak date July 12, but to show how great is the amplitude of these 12-month cycles. The average number of daily sunspots for 50 years is 53 on July 12 and only 34 on January 9, the peak being about 50 per cent greater than the valley.

In passing, let me say that I infer the existence of a stream of galactic electrons flowing sunward, the center of the stream being in heliocentric longitude 288 degrees.

The giant plant Jupiter has an orbital period of 11.86223 years; and the next smaller planet, Saturn, has an orbital period of 29.45772 years. The latter, significantly, causes a rainfall cycle of greater amplitude than the former. Even remote Uranus, whose orbital period is 84.0153 years, causes a noteworthy rainfall cycle, whose last peak date was 1909.23.

In studying the 84-year cycle curve as shown by varves, I noticed secondary peaks 21 years before and after the main peak. From this I infer that there are secondary streams of galactic electrons flowing sunward about in heliocentric longitudes 288—90 or 198 degrees, and (288 + 90)—360 or 17 degrees. The earth is in 198 degrees on April 9, and in 18 degrees on October 13. There are two great meteor showers whose peaks occur April 20, and October 20. I infer that they are due to streams of galactic electrons flowing sunward, carrying meteoric matter; and that when a planet crosses these streams its magnetic field tends to "focus" more of the electrons toward the sun, whence their subsequent escape affects our weather.

Electrons, it should be remembered, tend to reflect heat and light, whence it follows that increase in their number in the air over a given region must lower the temperature there, and thus tend to cause rain or snow. An Ice Age therefore is the result of a very great increase in electron numbers in the atmosphere over certain regions.

There are cycles 3.9 and 27 times as long as the Ice Age Cycle of 48,843 years. The one 27 times that length is the Geological Period.

Marine terraces caused by the 16,241 year cycles are spaced about 75 ft. apart in southern California, and their number, 23, indicates that that coast has been rising for about 370,000 years, or since the beginning of the Quaternary Age. Terraces cut on our Atlantic coast show that it has risen only two-fifths as much as our Pacific coast. By applying cycle data it follows that the Quaternary Age began 376,766 B.C.

I was able to date the Antevs' varves of the Ice Age, and thus to confirm the peak dates above given, by finding many cycles in each of his long series of varves. The longest unbroken series starts with a varve numbered 2700 and ends with one numbered 6277, covering nearly 3600 years. Antevs calls this his Hartford Series. I found that his varve 4400 was laid down 24,246 B.C., and marks the second cold, wet peak of the 1809-year cycle following the Ice Age peak. His varve 6209 marks the third peak of the 1809-year cycle after the Ice Age peak, and is therefore a peak of the 5427-year cycle. Antevs found varves resting on the underlying glacial till in only two places in this Hartford Series, namely bottom varve 4450 near Amherst, Mass., and bottom varve 6000 at Claremont, N. H., about 56 miles north of the bottom varve at Amherst. Hence the ice-front retreated a mile in about 28 years in this region. Near Claremont there is a recessional moraine, and about 4 miles north of Claremont there is the head of a 50-mile long train of boulders. A similar train

exists about 60 miles to the east, in another valley. I infer that near the wet peak of the 5427-year cycle, the morainal dams across these two valleys were washed out by excessive floods due to the spring melting of very heavy falls of snow. There is another long boulder train whose head is 15 miles north of Providence, R. I. Here another morainal dam evidently burst about the first peak of the 1809-year cycle after the Ice Age peak. The head of this boulder train is about 50 miles north of the terminal moraine; and therefore the average rate of retreat of the ice there was about 36 years to the mile, inclusive of "halts" while the terminal and the recessional moraines were being deposited.

Antevs measured a series of 700 varves near New Haven, Conn. By means of cycles I found the date of varve No. 20 to be 26,658 B.C., or 1206 years after the Ice Age peak. The second peak of the 603-year cycle after the Ice Age peak occurred when the ice-front was near New Haven, or about 30 miles from the terminal moraine.

Antevs measured a series of 952 varves near Hackensack, N. J., in a brickyard about 14 miles from the terminal moraine on Long Island. By means of cycles I found that varve No. 9 of this series was deposited 27,261 B.C. or 603 years after the Ice Age peak. Hence the rate of retreat of the ice front in the first 603 years after the Ice Age peak was about 43 years per mile. Antevs' Hackensack varve No. 1 rests on the underlying till where its northern end was at the ice-front. All these varves were deposited in glacial lakes, held by a morainal dam at the lower end and by the ice-front at the upper end.

Maps of recessional moraines in the Dakotas, Minnesota and Canada show horizontal spacings that indicate the 201, the 603 and the 1809-year cycles. Taylor's series of 14 recessional moraines in the Berkshires of western Massachusetts mark peaks of the 67-year cycle. The spacing of heads of "outwashes of sand" often mark floods due to the 22⅓-year cycle.

De Geer's varve in 1173 of the Vallby Series in central Sweden was deposited in 17,144 B. C., 134 years prior to a peak of the 5427-year cycle. That peak was 17,010 B. C., which is recorded by the major one of the Fenno-Scandian moraines. Its correlative is the broad morainal dam at the south end of the Canadian lake Timiskaming. The moraine at Cochrane, Canada, about 150 miles to the north, marks a peak of 1809-year cycle. The rate of retreat of the ice-front during those 1809-years was about 12 years to the mile, or nearly four times as fast as during the first 603 years after the peak of the Ice Age.

It has usually been inferred that Ice Age varves were thicker during warm phases of cycles, on the theory that the ice would then be melting faster, causing greater conveyance of silt. But an extensive ice-sheet delivers more water from the melting of the last winter's snow than from melting of the glacial ice. Hence the varves are usually thicker near wet peaks of cycles. Varves are thicker near the ice-front than far from it. Like shingles, they "feather out," as well as overlap. I find that when allowance is made for this "feathering out," varves are thicker near wet peaks of the 201, the 603 and the 1809-year cycles.

Varves deposited in glacial lakes usually vary much more in thickness than those deposited in seas. The latter are found consolidated into rock, and in any given region and period are usually quite uniform in thickness. I infer that marine varves are mainly the product of wave action, and that the same is true of most sedimentary rocks other than limestone.

The last rain peak of the 201-year cycle and all its subcycles was July 12, 1883. One of its subcycles is 7.444 years long, and its next rain peak will be February 1, 1943. This cycle "combines" with the Venus orbital period to cause a cycle that is only 1.4 days longer than 8 months. Its next rain peak will be December 20, 1942.

In a later article, evidence will be given showing that each of the cycles of the triple-progression series is caused by the rotation of an electron-shell that encases the sun. The length of each cycle of this series is the period of rotation of an electron-shell, and its wet, cold peak occurs when the south magnetic pole of the electron-shell is in heliocentric longitude 288 degrees. The longitudinal conjunction of such a magnetic pole and a planet is accompanied by a wet, cold peak. The mean length of such a conjunction cycle is found by multiplying the length of a given triple-progession cycle by the orbital period of a given planet and dividing the product by the difference between those two periods.

There are numerous short conjunction cycles of this sort, but I have found no evidence that the conjunction of any two plants causes a noteworthy increase either in sunspots or in rainfall.

There is, I believe, only one remaining problem of much difficulty crust in regions where the induced relating to the use of cycles in forecasting weather. I refer to the causes of opposed phases of the same cycle in different regions. A clue to this cause is the southward shifting of storm tracks near peaks of the 22⅓, the 67 and the 201-year cycles. The process is analogous to the shifting of sunspots to lower latitudes as a peak of the 11 1-6-year cycle draws near. Incidentally, that sunspot cycle is just half the length of the 22⅓-year rain cycle, which indicates that magnetic polarity of electrons due to their spiral motion is an important cause of difference between sunspot and weather cycles.

Cycles in Ice Age varves rarely show phase inversions, whereas the same cycles in tree-rings often show phase inversions; notably so in the California "big trees" or sequoias, and less often in the pines of northern Arizona. For this reason, as well as because the main Ice Age varve series measured by Antevs total more than 10,000 varves, I have come to rely upon those varves in cycle research with great assurance as to the deduced cycle lengths. For determining very long climatic cycles, rock strata are the most reliable, provided that enough varves are measured to determine the time required to deposit the sediments that built a foot of rock in the given locality. Alternate beds of shale and limestone record the cold and the warm phases of a cycle, whose length is usually determinable with considerable accuracy even if relatively few varves are measured. Each one of a sequence of beds of the same kind of rock (e.g., sandstone) if of comparatively uniform thickness, usually records a cycle of the triple-progression series whose length is determinable if the rock contains even a few varves. This fact seems not to have been recognized by geologists or meteorologists. It serves to confirm inferences from other facts that the cycles of greatest amplitude are those of the triple-progression series. Hence, for forecasting purposes, cycles of this series are of greatest value.

At first it seems very strange that great as well as small movements of the earth's crust record cycles whose lengths are the same as those of weather and climatic cycles. But the puzzle is solved by electron theory. Electrons in motion are magnets.

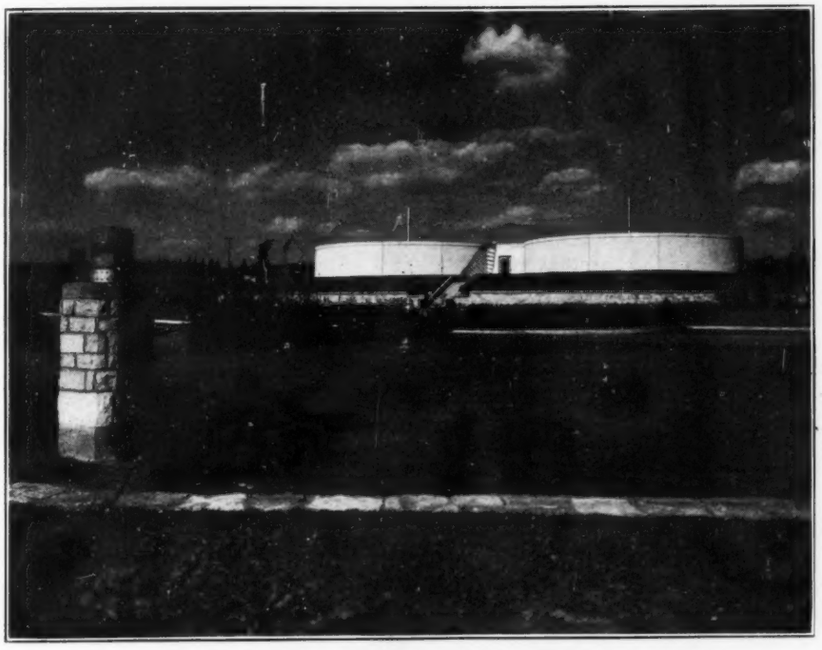
Hence with great numbers of solar or galactic electrons bombard the earth, they induce magnetism in all the paramagnetic matter in the earth's crust and core. This results in a downward movement of the magnetism is greatest, this vertical movement being greatest at peaks of the strongest cycles. As the weak phase of an electron cycle approaches, the crust in those regions rises again. Hence, every cycle tends, in a given region, to cause a downward movement of the crust during one half of the cycle, and an upward movement during the other half. Thus the Geological Period, which is a cycle about 1,320,000 years long, produced maximum depression of the crust in certain regions about 370,000 years ago, since which time the crust has been rising. But at electronic peaks of certain shorter but strong cycles, such as the 16,281-year cycle, there is a reduction in the rate of crustal uplift, which lasts long enough for sea waves to cut a wide terrace. As above stated, that cycle has cut 23 such terraces, inclusive of the one at the beginning of the Quaternary Age. Intermediate terraces of less width are to be seen at times, caused by the 5427-year cycle; and more rarely, in sheltered places, terraces due to the 1809-year cycle are to be seen.

Very great depressions of the crust have been accompanied by folding and faulting in certain regions, thus building mountains near peaks of the long cycle called Geological Periods, and more strikingly near peaks of the much longer (three times as long) cycle that may be called a Geological Era, and the one three times as long as that which may be called a Geological Age.

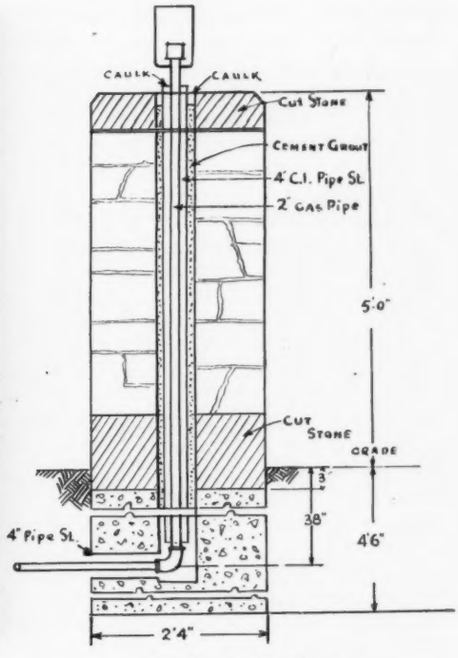
Even as short a cycle as the one 201 years long causes noteworthy depressions of the earth's crust in certain regions, e.g., in France in 1884, when after many years of slow subsidence the sea reached a maximum elevation all along the French coast. Archaeologists report a much greater subsidence of that coast about 700 B.C. As above stated, the 5427-year cycle had a peak 729 B.C. At about the same time French "Lake Dwellers" were driven from their homes built on piles because the lake levels rose. About 300 years later, many of those lakes went dry, which is clearly due to the dry phase of the 603-year cycle.

In a forthcoming book on Cycles, data supporting the statements and theories in this and previous articles will be given, besides a large amount of information not previously published. Each of the many kinds of cycles will have a chapter devoted to it. At the end of the book there will be numerous tables of thicknesses of varves, tree-rings and other data used in determining the lengths and dates of cycles.

THE WASTE GAS BURNER OF KANKAKEE



The Attractive Treatment of Kankakee's Waste Gas Burner



Details of the Burner

The Sewage Treatment Plant of the City of Kankakee, Ill., is picturesque. Its native limestone walks and retaining walls and attractive landscaping vie with the beauties of any well-kept park.

An example of the attractive and unusual features was the handling of the P. F. T. Waste Gas Burner installed in the premises near the two Floating Cover Digesters.

Instead of the burner with its pilot light and valve being left "out in the open" on its customary pipe pedestal, this unit is encased in a cut limestone column with the burner pot protruding from the top. Hardy Pfitzer's Junipers gracefully surround the column. The ensemble gives the effect of a rain gage in a garden.

Loewensohn, Pearson and Solomon, Inc., were consulting engineers. The "dressing up" of the waste gas burner was the artistic work of Mr. Pearson, architect of the firm.

Philip I. Schriner is superintendent of the Kankakee plant.

Operating Under W.P.B. Restrictions

THE water supply industry should be highly grateful to the American Water Works Association, to Secretary Harry Jordan in particular, for the interim releases of his valuable interpretations of the various portions of the current W.P.B. Order P46 in its amended form of October 10, 1942. Mr. Jordan's interim releases to the entire membership of A.W.W.A., which contain such interpretations and helpful guiding comments to water works operators, are only made possible as the result of the close contact and the understanding cooperative relationship which exists between the Secretary of A.W.W.A. and officials of the Power Branch of W.P.B. who have come to have a high regard for the American water works operator as a "square-shooter," anxious to do his utmost to shorten this war through cooperating with W.P.B. in the "Save, Stretch, Share" program of conserving critical materials.

In addition to Secretary Jordan's frequent trips down to Washington for clarifying and helpful conferences with W.P.B. authorities, it is of high interest, and untold value, to the water works profession to have the President of the A.W.W.A.—Abel Wolman—in the position of Special Consultant to Herbert S. Marks, Chief of the Power Branch of W.P.B. In fact so effective has been the influence of our "friend at court" as to cause to be set up, literally under the right wing of the Power Branch Chief, the Water Supply Division headed by Arthur Gorman chosen from the water supply operating field, and staffed by capable water works engineers and managers of long operating experience.

To us this situation is a rather remarkable one in an important governmental agency whose job it is to *regulate and restrict* the public utilities in their use (or abuse) of critical materials. There could be no higher testimonial to the fact that the water supply industry is held in the highest regard by the W.P.B. as to the intent and honesty—in brief, the conscientiousness or metal honesty—of the American water works operator. For this development the water works man has the good fortune of having had such individuals as Abel Wolman, Harry Jordan, Louis Howson, Boyd Bennett, Eugene Dugger, Reeves Newsom and John Kienle representing him in Washington. These men compose A.W.W.A.'s Special Committee on Wartime Problems, however, the practically continuous contact of these two "capables"—President Wolman and Secretary Jordan—has proved the old saying that a one man committee that really works is frequently the most productive sort of committee. Now, when one multiplies this by two and the answer comes out Wolman and Jordan, it is not difficult to understand how and why matters have been progressing so wholesomely for the water supply industry in Washington. Note that we did not say happily, but *wholesomely*.

For many, the present restrictions imposed under the amended P46 order may not be happy but we sincerely believe that much which will in the end prove healthful for the industry will come out of what is now transpiring. For instance, the new restrictions are making Mutual Aid schemes practically a MUST. Mutual aid in some form has to this writer's thinking for a long time appealed as a basically desirable practice in the water supply field—not alone at the time of emergency or disaster, but continuously so in respect to the pooling of interests of water utilities within ready transportation reach of each other in the matter of specific equipment which is not continuously needed by any single water works, but intermittently by all. In particular does the latter consideration apply in connection with the more costly equipment which many water works never purchase and, in consequence, either rent, or borrow, or else resort to the employment of makeshift equipment and archaic methods instead. In the February 1939 issue of *"Water Works and Sewerage"* the writer first voiced his thoughts, regarding the potentialities of Mutual Aid, in an editorial captioned—*"Friends in Need."* In it was expressed, as "a thought for the day," the suggestion of what has now come to be known as the "Mutual Aid Plan," except that it was to be on a zone or district scale rather than on a state wide scale.

Another interesting outcome of W.P.B. restrictions is that many a water works manager will learn just about what a water utility of given size should maintain in the way of an inventory of materials and equipment which will prove adequate without extravagance. It will be found that the majority of the smaller water works never did have an adequate inventory, while many had badly unbalanced inventories of supplies and materials.

Aside from materials and equipment the water works manager of tomorrow will know where and how manpower can be "stretched" to the maximum advantage —where womanpower can most effectively be employed. And, many a water utility head will learn that properly chosen women can be superior to men for a number of water works jobs.

The water works manager will learn of the economic advantages of "saving and stretching," as applied to his system in the nature of surveying for waste and leakage, distribution system weaknesses, pumping inefficiencies, the restoration of pipe line capacities through main cleaning, and the advantages of cement lining and/or treatment to hold the gains thus secured, the worth of ample and strategically located storage, the fact that a "substantial wartime coagulant may be superior and more economical than a long used standard product. He may also learn how to make one service line to the curb and a single meter-box do the work of two.

But, whatever he may learn, he will never learn that manpower is a substitute for machines and modern mechanical equipment. Another thing he will not learn is that his staff know enough of the details of the system, or that he had too many valves or fire hydrants in the system, or that his water storage was overdone.

We have been impressed with the fact that it has taken total war to teach us many things that can be done and many things that needed to be corrected in our "American way of life," as we termed it. In the water works industry we realize the more every day that out of this war are coming certain water supply practices which are to represent a healthy and economically sound advance in more ways than one.

In the meantime let us be thankful for our effective representation (and representatives) before the War Production Board in Washington. If we are to get the most out of the situation it is our part to "play the game" just as squarely with the W.P.B. staff as water works operators have the reputation for doing amongst their own. Until there is something to mar the present relationship, W.P.B. stands ready to take every water works operator on his own word. Operators have the honor of their profession to uphold. And, a give and take attitude will go far in making life easier for one and all. By thinking foremost of winning this war one can take a lot in these times, and water works men have never been known to quit a pipe job just because the trench caves in on them when a storm strikes.

MEETINGS SCHEDULED:

Dec. 30—NEW YORK, N. Y. (Commodore Hotel).
New York Section, A.W.W.A. Mid-Winter War Conference. Sec'y-Treas., R. K. Blanchard, Neptune Meter Co., 50 W. 50th St., New York, N. Y.

Jan. 20-21—NEW YORK, N. Y. (Eng. Societies Bldg.)
American Society of Civil Engineers. (Annual Meeting.) Exec. Sec'y, Geo. T. Seabury, Eng. Societies Bldg., 33 W. 39th St., New York, N. Y.
(Sanitary Engineering Div. Sessions, Thursday, Jan. 21.)

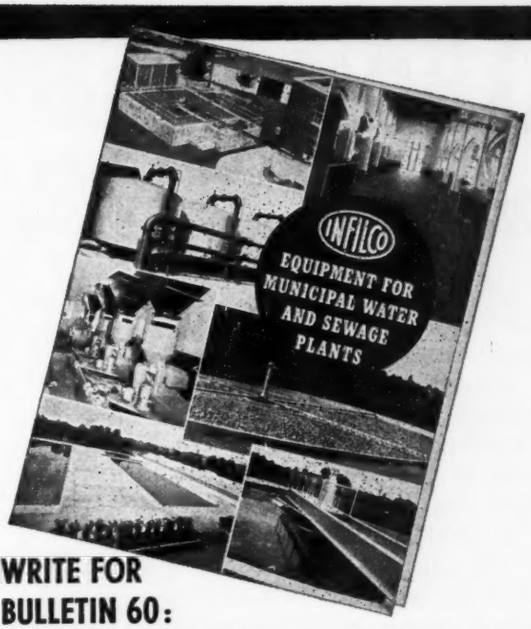
Jan. 22—NEW YORK, N. Y. (Hotel McAlpin).
New York State Sewage Works Ass'n. (Hotel McAlpin.) Sec'y-Treas., A. S. Bedell, State Dept. of Health, Albany. N. Y.
(Joint Annual Dinner of N.Y.S.S.W.A., and the Sanitary Eng. Div. of A.S.C.E., Jan. 22. Inspection trip scheduled for Jan. 23, cancelled.

Mar. 12-13—MINNEAPOLIS, MINN. (Nicollet Hotel).
Minnesota Section, A.W.W.A., Sec'y-Treas., R. M. Finch, 416 Flour Exchange, Minneapolis, Minn.

Apr. 7-9—HAMILTON, ONTARIO (Royal Connaught Hotel).
Canadian Section A.W.W.A. Sec'y, A. E. Berry, Ontario Department of Health, Parliament Bldgs., Toronto, Ont.

May 7-8—BELLINGHAM, WASHINGTON
Pacific Northwest Section, A.W.W.A. Secretary, Fred Merryfield, Engineering Laboratories, Oregon State College, Corvallis, Ore.

June 14-17—CLEVELAND, OHIO (Carter & Statler Hotels).
The 1943 A.W.W.A. Conference on WAR WINNING Water Works Operations. Executive Secretary, Harry E. Jordan, 22 East 40th Street, New York, N. Y.



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Administration and Operation

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Bureau of Sewers, Baltimore, Maryland

673 pages, 6 x 9, 177 tables, 167 diagrams, charts, graphs, and illustrations, $6.00

This practical manual comprehensively presents the problems of administration, operation, maintenance and design of sewage-treatment plants, and how to handle them.

Drawing upon actual operating results and experience obtained at a large number of outstanding sewage works, this book covers sewage treatment in a thorough and practical manner—from characteristics and composition of sewage, through the various stages of treatment, to its eventual disposal.

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Water Works & Sewerage

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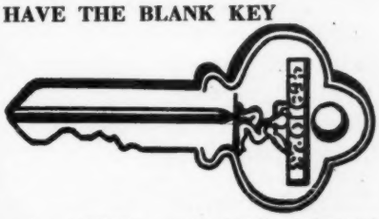
155 East 44th Street, NEW YORK

288-D

Did Your Corporation or Company Lose a "Key Man" in the Draft or Manpower Shuffle?

PERHAPS I HAVE THE BLANK KEY



For You to Quickly Shape to Your Present War Problems and Future Long Range Needs.

The man who put the percent (%) sign to work in the sanitation field and made it internationally known by founding and promoting %Proportioneers, Inc.% will consider situations in any field utilizing past experience and capabilities—could handle industrial sales promotion and advertising; corporate executive and engineering work; field work in sales, service, or research.

Age 42, B.S. in M.E.

Reasonably Draft Proof—dropped to occupational "3b" from normal "3a" draft rating due to family of two growing children.

10 Past Years' Experience as President of %Proportioneers, Inc.% included invention, research, development, administration, sales promotion, creative advertising writing, field and market investigation, engineering and production expediting; especially in the field of water purification and chemical feeding for the armed forces and the general water and industrial fields.

Willing to Go Anywhere in the World for initial salary of around ten thousand after sufficient interval to dispose of residence, and other properties.

Effective December 11, 1942, I have resigned as President and Director of %Proportioneers, Inc.%, Providence, Rhode Island, for reasons which may be disclosed under proper circumstances.

Available March 1, 1943, at termination of my employment and all active connection with %Proportioneers, Inc.%, but could arrange more immediate action.

If the Key Fits Your Problems, Wire, Phone or Write My Residence, Tel. Hopkins 1529—51 Paine Avenue, Cranston, Providence, Rhode Island.

Incidentally,—I utilize this space also to convey **Season's Greetings to my friends and acquaintances in fields I have been associated with for the last decade. Merry Christmas and a Good New Year.**

(Signed) Jeff Corydon

No Grounds for Complaint!

Like the civilians of so many American municipalities, personnel at many training and production centers can enjoy well kept surroundings, thanks to the Royer Sewage Sludge Disintegrators that the foresighted officers and executives of these establishments have put to work. Their well-kept grounds make these war establishments a better place to live, pepping up morale.

These Royers shred, mix and aerate dehydrated or dried-under-glass sewage sludge cake, reducing it to pea size particles that make ideal lawn top dressing and a soil conditioner for flowers and shrubbery and bedding plants.

The administration, recreational, hospitalization and many other buildings at these establishments have taken on the aspect of a campus. Beside providing material that increases soil fertility, these Royers have solved the sludge disposal problem.

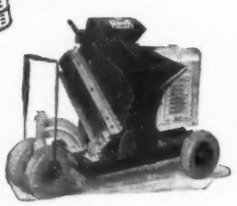
Establishments for war production and training vary in population just as cities do and there is a properly sized Royer for every camp or plant from the largest to the smallest. Users report, too, that the performance of the Royer leaves no grounds for complaint.

There isn't a father of a son among us who doesn't want to see the needs of the boys in service and ordnance plant workers administered to ahead of civilian needs even if it means that your municipality may have to wait for the "duration" for a Royer!

ELECTRIC

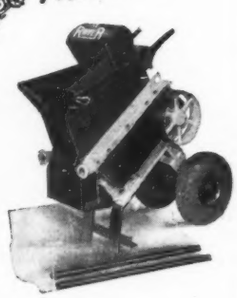
The "S-Jr.," electric powered; also available with gas engine. There are 12 stationary and portable Royer models.

GASOLINE



The Model "SO," one of 3 gasoline engine powered models.

TRACTOR



Model "SK," one of several models with pulley for belt-to-tractor power or other available power. Send for complete data.

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LITERATURE AND CATALOGS

"Our Family Album"—is the absorbing chronicle of the inventive pioneering and industrial development of the world's largest manufacturer of liquid meters. In issuing this handsomely bound, 125-page, golden anniversary book, Neptune Meter Co. looks back over fifty years of its progressive history, and tells of the men, ideas and events that contributed to make Neptune the forward organization that it is today. The story begins with the inventing activities of John Thomson during the 1880's and the marketing of his disc "B" meter in 1892, and does not end until it has introduced the reader to all persons who have made Neptune history up to the present day.

The latter part of the anniversary book is called the "Neptune Gallery," and in it can be found photographs of every Neptune man in the United States and Canada. The photographer swears that he searched "everywhere except in the jails for Neptune wanderers." The photographs and sub-titles reveal the high standard that Neptune uses in selecting its extensive sales organization and other personnel.

All friends of Neptune will undoubtedly want a copy of this handsome and expensively produced Album to better familiarize themselves with some of the men who have made meter history. For a copy, write Neptune Meter Co., 50 W. 50th St., New York, N. Y.

Permutit Spaulding Precipitators—are the subject of a new illustrated bulletin, No. 2204. These units are chiefly used for water softening; removal of turbidity, color, taste and odor; alkalinity removal; removal of silica; and removal of fluorides. They operate on the principle of keeping the precipitates suspended within controlled limits and allowing the water to pass upward through the precipitates at a controlled speed. Water to be treated and necessary chemicals are introduced into the mixing zone and are slowly agitated with the suspended sludge particles. The flow then passes through a constricted opening into the "sludge-filter" zone. As the particles here agglomerate and become larger they no longer are suspended by the velocity of flow and hence fall back into the mixing zone, creating a continuous flow of suspended particles from the mixing zone to the filter zone and a counter-flow of larger particles in

the opposite direction. The clear water is taken off above the filter zone; the sludge may be blown off from any point within the sludge area. Besides several photographs of Permutit Precipitators in operation, the bulletin contains cut-away drawings and a flow diagram showing all features of these units offered for flows of 1,000 to 10,000,000 gallons per day. A copy of Bull. 2204 can be obtained by writing the Permutit Co., 330 W. 42nd St., New York, N. Y.

The Graver Chemical Mixing Tank, described and illustrated in their new bulletin Form 312, consists basically of a vertical cylindrical steel tank equipped with a driving mechanism, outlet swing-pipe, agitator paddles, and perforated baffle plates extending across the full depth and diameter of the tank. Sufficient quantities of chemicals can be thoroughly mixed for the continuous treatment of a water supply over periods ranging from 12 to 24 hours. Also described in the bulletin is a Chemical Proportioner, designed for accurate automatic control of chemical feed in proportion to incoming raw water; and a Remote Control Proportioner, which makes it possible to locate the flow meter at any point in the water line, regardless of its distance from the proportioner and chemical feeder. A copy of bulletin Form 312 can be obtained by writing Graver Tank & Mfg. Co., Inc., East Chicago, Ind.

Graver Pressure Type Water Filters are described and illustrated in their new 12-page bulletin, Form 313. Cross-sectional drawings and photographs show all design data and operating features of the equipment. The bulletin shows several typical arrangements for multiple units. Numerous filter accessories, such as automatic valves, pressure gauges and flow indicators, are shown. Included with the bulletin is a "Filter Plant Questionnaire," which, when properly filled out, will enable Graver engineers to make recommendations as to type and size of equipment needed for individual requirements. A copy of the bulletin may be secured by writing Graver Tank & Mfg. Co., East Chicago, Ind.

Pozzolith is recommended for more durable and economical concrete in a 32-page illustrated brochure recently received from the Masters Builders Co. of Cleveland, Ohio. This cement dispersing agent is added to the concrete mix at the mixer. By deflocculating and peptizing the cement particles it markedly increases the effective surface area of the cement, increases the plasticity of the mix, and reduces the excess water required for placing the concrete. Numerous photographs of buildings, bridges and dams show the wide application of the product. The story of Pozzolith's strength and durability are told in a series of graphs, giving the results of various laboratory tests. To obtain a copy of the brochure, address the Master Builders Co., Cleveland, O.

"Ferri-Floc," a partially hydrated ferric sulphate, is described in an illustrated 24-page booklet recently published by the Tennessee Corporation. The Ferri-Floc is recommended for the coagulation of waters, sewage and industrial waters over a wide pH range. The partially hydrated material is less hygroscopic than anhydrous ferric sulphate, thus permitting its shipment in bulk cars for storage in open bins. Laboratory and plant tests show that Ferri-Floc can produce coagulation equal to that of anhydrous ferric sulphate. The booklet contains detailed data of applications of Ferri-Floc in water

Portsmouth, Va., with a heavy influx of Navy Yard workers, increased its water supply from 6,000,000 to 13,000,000 gallons per day by building a 13-mile water line of 30-in. concrete pipe. Laying crew placed 400 ft. of pipe daily.

Defense-area water and sewerage projects need the durability and economy of

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Concrete pipe has proved its durability on a vast scale, with installations dating back half a century and more. While conserving critical materials, it fully meets ALL the requirements of moderate first cost, structural safety, minimum infiltration and leakage, and maximum hydraulic capacity.

Technical assistance is available to engineers and builders engaged in vital wartime projects involving concrete pipe or other concrete construction.

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and sewage plants. The results of tests at several large municipalities are given. To obtain a copy of the booklet write to the Tennessee Corporation, Atlanta, Ga.

Chain Drive Maintenance and First Aid is discussed in Folder No. 1951, recently printed by the Link-Belt Co. This timely factual folder tells what can be done to keep chain drives running when you can't get repairs or replacements. It explains what to do for worn chains and for worn wheels, and tells how to get new life from old chain pins. The folder lists "Seven Servicing Suggestions" that should make any chain drive run better and faster. For a copy of Folder No. 1951, write to the Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

V-Belt Maintenance and Care is the subject of an interesting 12-page manual recently prepared by the Engineering Bureau of the Multiple V-Belt Drive Association. The manual is designed to aid power users in the proper selection, installation and maintenance of their multiple V-belt drives and thereby obtain the maximum life out of every V-belt. Twenty-three important suggestions are given for conserving the life of belts, sheaves and drives. Drawings show the proper and improper way of operating and servicing equipment. For a copy of this conservation manual, write to Multiple V-Belt Association, 140 S. Dearborn St.,

A Motor Fitness Manual is a storehouse of suggestions on how to get the greatest value out of your new and old electric motors. Although primarily designed for plants converted to war production, the new manual contains information that will interest many utility engineers. It tells how to be sure of "motor fitness" under three general conditions: (1) when motor-equipped machines must be shifted to new jobs; (2) when machines require new motors, or motors must be shifted to other jobs; (3) when it is necessary to operate motors on a strenuous wartime schedule. A supplement explains how to save critical motor materials, including WPB recommendations, and information on the use of load-time-temperature charts. Those interested in the Motor Fitness Manual can secure a copy by writing General Electric Co., Schnectady, N. Y.

Water Handbook, a new technical book on chemical control of industrial and municipal water, has just been published by W. H. and L. D. Betz. The book is divided into two sections, the first discussing 25 methods of water analyses, their procedures and calculations. Hardness, Alkalinity, Phosphate, Sulfite, Turbidity, Oil, Calcium and Specific Conductance are among the analyses studied. These tests are simple determinations requiring little or no previous chemical background. The second section of the book, devoted to interpretations of the tests, includes discussions of such subjects as Carbonate and Non-carbonate Hardness, pH Control, Steam Purity and Inter-crystalline Cracking. Sixteen useful technical graphs and numerous illustrations of testing equipment are shown. The price of the 64-page handbook is 50c postpaid. Requests should be addressed to W. H. and L. D. Betz, Gillingham and Worth Streets, Frankford, Philadelphia, Pa.

Panel Instruments of the Roller-Smith Company are described in their new illustrated Catalogue No. 4120. The catalogue covers their line of 3 in. and 4 in. instruments, round and square cased, and includes specifications, recommended

Dependable Protection...

Against RUST✓
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ABRASION✓
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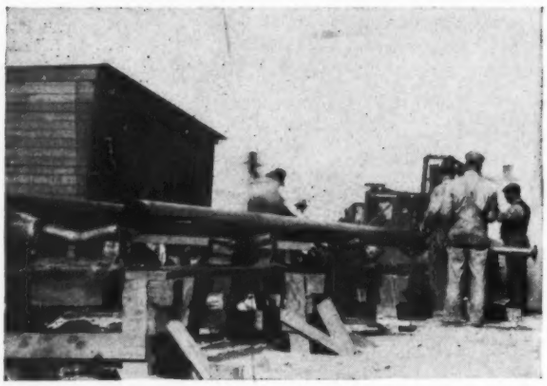

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Booklet describing REILLY *Protective Coatings will be sent on request.*

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uses and list prices. Capacities and dimensions of a complete line of shunts are given. Alternating and direct current ammeters, voltmeters, single phase and polyphase wattmeters and radio frequency milliammeters are among the instruments illustrated and described. Included also are RT current transformers for ratios up to 500/5. A map on the back cover shows the location of Roller-Smith agents throughout the country. A copy of Catalogue 4120 may be had by writing Roller-Smith Company, Bethlehem, Pa.

Technical Books in All Important Fields, are included in the Chemical Publishing Company's new 1942-1943 catalogue that has just been released. Engineering, Aviation, Radio, Electricity, Mechanics, Chemistry, Formulas, Military and Naval Sciences and Dictionaries are all covered. The organization of this 64-page catalogue is especially designed to increase its utility and efficiency. Sections have been subdivided so that books on similar subjects can be found in a minimum of time. An all-out war effort has produced a wealth of technical literature, and these books should prove valuable to both engineers and students. Also included in the catalogue are the Spanish and Portuguese books of Editorial Technica Unida. A copy of the 1942-1943 catalogue will be sent on request. Address: Chemical Publishing Company, 236 King Street, Brooklyn, N. Y.

Modern Laboratory Equipment is the title of Chemical Rubber's new Supplement D-1, an 88-page illustrated bulletin showing the latest equipment available to the nation's laboratories. These supplements are issued between publications of the regular catalogue. Supplement D-1 contains a large variety of laboratory fixtures, glassware and recent inventions of proven merit. A Cameron glass electrode pH meter and several models of Beckman pH meters are shown. The Chemical Rubber Co. has been selecting and marketing laboratory equipment for more than 30 years. Copies of their new Supplement D-1 can be obtained by addressing Chemical Rubber Company, 2310 Superior Ave., N. E., Cleveland, Ohio.

Wet-Cell Flashlight Batteries represent a substantial economy in small tool expense, according to a new illustrated folder issued by the Ideal Commutator Dresser Co. The new "Ideal" battery weighs but seven ounces and fits into a standard flashlight case. Among the advantages claimed by its manufacturer is that it supplies a constantly bright light, requires little care, and can be used continuously for hours. Single and gang rechargers for building outlets are available, as well as a compact charger for mounting on auto steering columns. For a copy of the folder describing the re-chargeable flashlight battery address the Ideal Commutator Dresser Co., 1273 Park Avenue, Sycamore, Ill.

BUY

WAR BONDS

THERE'S A GREAT DAY COMING...

Somewhere in England our Norm is fixing QMC trucks. John is piloting paratroopers. Joe's an artilleryman in Hawaii and Red's in an armored regiment in Louisiana. George has become a radio instructor. Chuck left last week for basic training, and Lee was sworn in yesterday. These and others, and others-to-come will do their part in the armed forces. We want them all back, God willing.

But we here don't feel "left behind." For in this kind of Total War we are doing our assignments cheerfully and, we believe, helpfully. Part of our job is to build greater opportunities for Norm and John and Joe, for Red and George and Chuck and Lee and the others—to have things ready, bigger and better, when they come back.

Our courage is high. We are sure of Victory! *There's a Great Day Coming!!*

GENERAL PAINT CORPORATION
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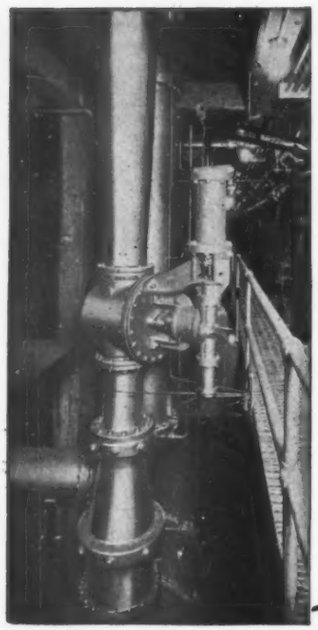
Which Primary Element?

VENTURI TUBE, FLUME, WEIR, ORIFICE, OR NOZZLE



The primary element for your metering application should be selected not arbitrarily but by the requirements to be fulfilled and by the economic considerations entering into the installation.

Sewage and sludge are often, though not always, measured by Venturi Tubes, Flumes, or Weirs.

Water may be satisfactorily measured by any type of primary element. Factors such as the cost of pumping, the pressure and the size of pipe or channel usually dictate the device used.

Steam is usually measured by the Bailey Orifice or Flow Nozzle.

Bailey Meter Company holds no brief for any particular primary element, its only interest is in making sure that the user secures the highest accuracy and reliability at the lowest expense.

Detailed information on the advantages of various types of primary elements furnished on request.

MU-18

BAILEY METER COMPANY

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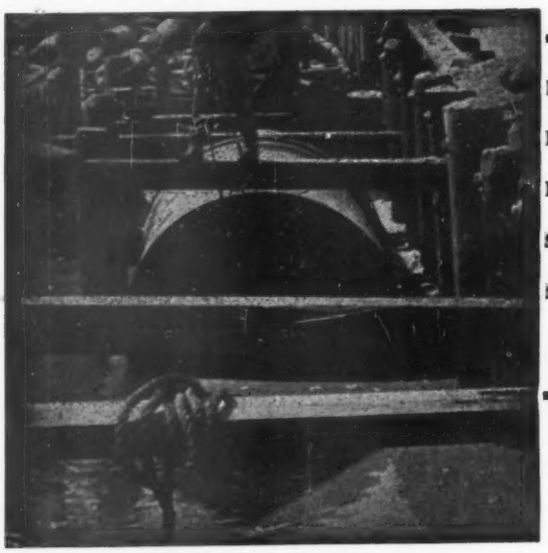
Bailey Meter Company Limited, Montreal, Canada



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Large stock enables us to make prompt shipments.

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Warren Pipe Company of Mass., Inc.

75 Federal St., Boston

Micromax Smoke Density Recorders, is the subject of a 16-page illustrated catalogue recently received from the Leeds & Northrup Co. A sampler, attached to stack or breeching, consists of two intake and one exhaust channels. Two streams of stack gas are drawn into the measuring chamber, assuring a typical sample. Radiation, from a voltage-controlled lamp, falls on a series thermocouples in inverse proportion to the density of the smoke. The electromotive force generated by the thermocouples is measured by an indicating and recording pyrometer. With this equipment a man on the firing aisle can know the density of the stack discharge by a glance at the indicating recorder. The instrument can be equipped with signalling lamps, usually a set of five lamps, each a different color to represent five progressive smoke densities. The catalogue describes and illustrates both the Model R Indicating Recorder, containing a large pointer and circular 24-hour chart; and the Model S Recorder, providing a permanent record on a strip-chart. For a copy, ask for Catalogue M-93-163, from Leeds-Northrop Co., 4934 Stenton Ave., Philadelphia, Pa.

Taylor Pressure Instruments are described and illustrated in Taylor Instrument Company's new Catalogue 76JF. Three types of instruments for indicating, recording, and controlling pressure are featured. The Bourdon spring type instrument is used to measure pressure from 25 to 10,000 pounds per square inch, and to measure combined pressure and vacuum. The Bellows type instrument covers a range of from 5 to 25 pounds, while the manometer type measures pressures up to 5 pounds. Special features of the Taylor pressure instruments make them sensitive to slight variations in pressure but assure stability under severe operating conditions. Also included in the catalogue is a description of the Taylor mercury-column gauge for absolute pressure and vacuum. The 24-page book contains complete specifications, details of design, photographs of models, tables showing the range of charts, and instructions for ordering. For a copy of Catalogue 76JF address the Taylor Instruments Co. at Rochester, N. Y.

EQUIPMENT NEWS

Helpful "Motor Finder"

HERE'S YOUR MOTOR!
DESCRIPTION OF STANDARD TYPES
"AR X" type
NEW, SPECIAL and OTHER TYPES
HOW TO PICK THE RIGHT SQUIRREL CAGE MOTOR!
Allis-Chalmers Motor Finder

● To help motor users fill their wartime motor needs with the least possible delay, as well as conform to recent WPB recommendations, Allis-Chalmers is offering a new "Motor Finder" for quickly selecting the various types of squirrel-cage motors.

Standard types of the squirrel-cage—the most readily obtainable motor—are actually even more versatile than is commonly realized. Because of this, and important savings in time and materials due to standardization, WPB is urging careful consideration of the squirrel-cage types first.

With the new "Motor Finder" (slide-rule), the motor user is able to match the conditions under which the motor must operate at the proposed installation with the required motor characteristics and instantly learn the right motor type and its features.

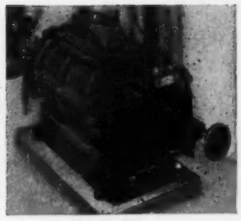
So handy is the new "Motor Finder", that only three simple steps are necessary to pick a motor. Since over thirty standard types, covering a range in horsepower from ½ to 75, are included in the Allis-Chalmers Lo-Maintenance line, all of the characteristics of versatility of squirrel-cage motors are immediately considered in using the slide-rule. The potential motor buyer thus takes fullest advantage of the most available motors he can buy in wartime.

Copies of the "Motor Finder" can be obtained free of charge from the Allis-Chalmers Mfg. Co., Milwaukee, Wis.

BUY WAR BONDS AND

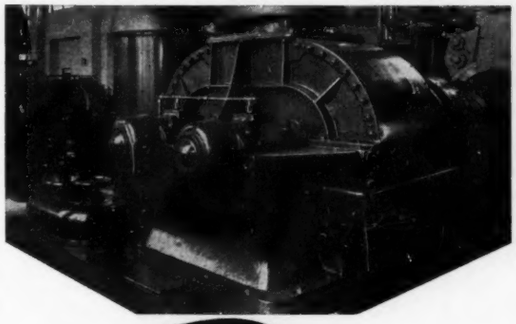
SAVINGS STAMPS

VACUUM PUMPS
Dewatering sludge filters at Washington, D C.



ROTARY METERS
Accurately measure sludge gas at Richmond, Indiana.

AERATING BLOWERS
Two gas engine driven blowers at Gary, Ind. Capacity each, 7,800 CFM at 8 lbs. pressure.



ECONOMICAL SEWAGE TREATMENT

The efficient design, long life, and trouble-free operation of Roots-Connersville air and gas handling equipment is a great aid in making the activated sludge type plant effective and economical.

While war-time restrictions may limit new construction at present, we can give you, now, a lot of information, gathered in our long experience, which will prove of value to you later on when you are ready to go ahead with plans that are temporarily delayed. Ask for Bulletin 23-B-12. There's no obligation.

ROOTS-CONNERSVILLE BLOWER CORPORATION
212 Mount Avenue,
Connersville, Ind.

All Out for Victory

Put Your Scrap Into the Fight!

Roots Connersville Since 1854 Aerating BLOWERS

☆ ☆ ☆ ☆

☆ ☆ ☆ ☆

Permanent . . . . .

REDWOOD PIPE Saves critical materials! Long known as a pipe with greater carrying capacity than metal or concrete. Does not clog, scale or pit.

WYCKOFF Since 1855

LOWER labor, installation and maintenance costs. Long life, no electrolysis, contamination of water, or destruction by sulphur, salt water or other mineral impurities. New type Wyckoff California Redwood Pipe for water supply and sewage lines is a proven product.

A. Wyckoff & Son Company

ELMIRA, N. Y.
Originators of Machine Made Wood Pipe
1855 — Our 87th Anniversary — 1942

☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆ ☆

GET MORE FOR YOUR MONEY

in activated carbon—

CHECK PERFORMANCE *before you buy*

Use the Threshold Odor Test. Start a Carbon Feed Chart. Both are scientific, simplified methods that determine the most effective carbon for your plant!

Ask for a sample of Hydrodarco, the activated carbon specially made for water treatment. Check its performance—and be convinced that Hydrodarco delivers maximum palatability control per dollar! Join the waterworks men who have found that a small difference in price may mean a large difference in odor-removing efficiency.

HYDRODARCO

Distributing Points: New York, Cincinnati, St. Louis, Buffalo, Chicago, Kansas City, San Francisco, Los Angeles, Marshall, Tex.

Hydrodarco—Reg. U. S. Pat. Off.

DARCO

DARCO CORPORATION

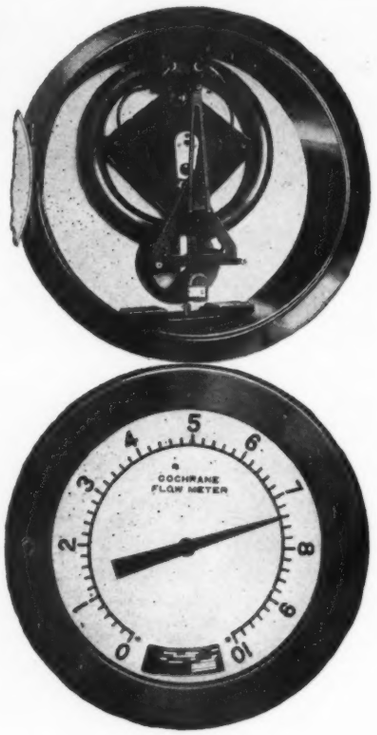
60 East 42nd St., New York, N. Y.

Two Pen Flow Recorders

Where panel space is at a premium, or where it is desired to have two related flow records on the same chart for ready comparison, the new 2-pen Cochrane electric flow meter (actually two complete Cochrane flow meter receivers mounted within one double depth case) achieves the result without complication and with no loss of accessibility. Both receiver mechanisms continue to operate while in swung out position.

Where two related measurements are involved, the operator has often sufficient guidance by observing the coincidence (or lack of it) of the two pens. However, this does require that he note which pen is which. For cases where continual reference must be made to this relationship of the two records, a ratio indicating pointer can be incorporated. Its clearly visible red target moves to right or left from the center point on the scale and thus shows at a glance whether there is an excess or deficiency of one of the quantities with respect to the other.

An integrating unit can be furnished on both mechanisms but reading of rear mechanism integrator requires opening of the case. For descriptive leaflet write Cochrane, 17th and Allegheny Ave., Philadelphia, Pa.



Recorder—Closed and Open
New Cochrane Two Pen Flow

Official Navy Photo

"Jap Slappers!"

NAVY MEN CALL THEM "P. T. BOATS"

Small, light and with an amazing amount of speed, the famed "P. T. Boats" can outmaneuver any destroyer, cruiser or battleship the enemy has ever built. They carry a death sting in their fore and aft torpedo tubes. And for their splendid accomplishments as fighting crafts, they are the pride and joy of the Allied naval men the world over. Their worth has been admirably proven on the field of action.

Layne Pumps and Well Water Systems bear an amazing similarity to the P. T. Boats, on the points of sturdiness. First in genuine quality and second, in that they, too, have proven their worth on the field of action. These Water Systems have been designed and are being built to fulfill a tremendously important task—that of providing millions and millions of gallons of water under any and all conditions. Throughout the Nation, the name Layne is as famed in the water producing field as is the name of P. T. Boats in Naval warfare.

Hundreds and hundreds of Layne Well Water Systems are now serving army camps, naval stations, ship yards, flying fields and munitions plants. Their quality is worthy of outstanding recognition. For late catalogs, bulletins, etc., address

LAYNE & BOWLER, INC.
Memphis, Tenn.

LAYNE
PUMPS & WELL WATER SYSTEMS

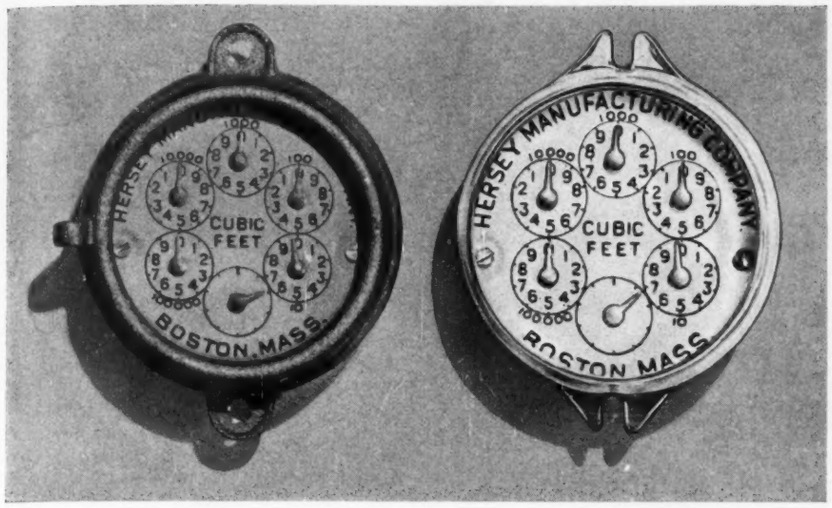
Affiliated Companies

Layne-Arkansas Company.....Stuttgart, Ark.
Layne-Atlantic Company.....Norfolk, Va.
Layne-Bowler New England Corp...Boston, Mass.
Layne-Central Company.....Memphis, Tenn.
Layne-Northern Company.....Mishawaka, Ind.
Layne-Louisiana Company.....Lake Charles, La.
Louisiana Well Company.....Monroe, La.
Layne-New York Company.....New York City
Layne-Northwest Company.....Milwaukee, Wis.
Layne-Ohio Company.....Columbus, Ohio
Layne-Texas Company.....Houston, Texas.
Layne-Western Company.....Kansas City, Mo.
Layne-Western Co. of Minn.....Minneapolis, Minn.
International Water Supply, Ltd...London, Ont.

WORLD'S LARGEST WATER DEVELOPERS

Hershey's Wartime Meters

In Which the "Magni-Vision" Register Box Is Featured



• An interesting feature of the Hershey's new ⅝" Models ICF and ICHF wartime water meters is the use of the water-tight "Magni-Vision" glass register box, which enlarges and clarifies the figures on the register dial. This improvement makes for accurate and quick readings as the accompanying picture reveals. Model ICF meters are also offered in ¾" and 1" sizes, provided with iron bonnets and lids uniform in quality with the high grade cast iron cases on all sizes. The top casings of all meters are treated with a coating of black baked enamel, which presents a uniform and continuous coated iron structure for encasing the interior parts.

Models ICF and ICHF meters are similar in structure to the Hershey Models F and FH disc meters, which are presently used by many water works systems. All sizes contain the well known three-piece Hershey measuring chamber with the enclosed intermediate gear train, providing protection against deposits of foreign matter. Interior parts of the Model ICF meter are interchangeable with similar parts of the bronze case Model F meter, and interior parts of the Model ICHF meter are interchangeable with those of the bronze case Model HF and HD meters. This permits a convenient switch from cast-iron to the bronze case should such prove desirable later.

For an interesting folder and additional information, address the Hershey Manufacturing Co., South Boston, Mass.

New Form Lining for Producing Improved Concrete

• Dr. W. A. Gibbons, Director of Development for the U. S. Rubber Co., has recently announced a new concrete form lining which is said to make concrete several times more resistant to weather and abrasion in dams and construction projects.

Christened "Hydron," these linings consist of an absorptive material faced with fabric. It is applied to concrete forms by stapling. The material is light and sufficiently flexible to be used on curved surfaces. After the forms have been removed the fabric is easily peeled from the concrete, leaving a smooth surface that requires no refinishing.

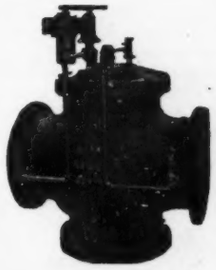
Hydron removes the water and air bubbles from the surface of the concrete and produces a high density surface that will last longer than that secured with ordinary forms. Recent weathering tests show that concrete cast against Hydron will withstand four times as many freeze cycles as samples cast against wood. The new lining is already being used on several large dams and fortifications. For additional information write to the United States Rubber Co., Rockefeller Center, New York, N. Y.

· 1879 ·
ROSS
AUTOMATIC VALVES

ALTITUDE VALVES • SURGE • RELIEF • BACK PRESSURE VALVES • FLOAT VALVES • REDUCING AND REGULATING VALVES

ALTITUDE VALVES
for
Control of elevation and heads into and out of tanks, basins and reservoirs.
1. Single acting.
2. Double acting.
3. Combination assembly for three or more automatic operations.

COMBINATION VALVE
Combination automatic control both directions through the valve.
A self-contained unit, with three or more automatic controls.



REMOTE CONTROL VALVE
Electric remote control—solenoid or motor can be furnished.
Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

ROSS VALVE MFG. CO.
INCORPORATED
P. O. BOX 595, TROY, N. Y.

★ THE NATIONAL METHOD • OVER 35 YEARS EXPERIENCE ★

GUARANTEED TO RESTORE 95% ORIGINAL CAPACITY

DEFENSE DEMANDS

FULL CAPACITY MAINS

Before Cleaning

After Cleaning

MANY cities that now find their water supply resources sadly overtaxed by the additional thousands of water users in defense industries and nearby army training camps, are turning to the *NATIONAL METHOD of water main cleaning* as an economical means of improving water service.

Cleaning by THE NATIONAL METHOD restores clogged mains to at least 95% of their original carrying capacity, making unnecessary large expenditures for auxiliary pipe lines, increased power at the pumps, new standpipes, etc.

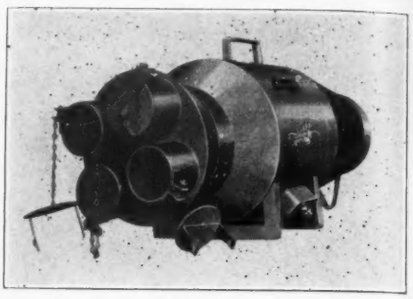
The NATIONAL METHOD

The National Water Main Cleaning Co.

30 Church St. Branches: New York

115 Peterboro St., Boston, Mass. — 406 Fla. Theatre Bldg., Jacksonville, Fla.
910 William-Oliver Bldg., Atlanta, Ga. — 205 W. Wacker Dr., Chicago, Ill.
7103 Dale Ave., St. Louis, Mo. — 501 Howard St., San Francisco, Calif.
3812 Castellar St., Omaha, Neb. — 2028 Union Ave., Montreal, Can.

Octapus Exhauster-Blower



● The Chelsea Fan and Blower Co. of Irvington, N. J. to meet numerous requests to construct a small portable unit to eliminate gases or fumes from tanks, cabinets, pits, manholes, etc., have produced the "Octapus Jr." exhauster.

This powerful little exhauster and blower is powered by a ¾ h.p. ball bearing motor. . . . Newly developed heavy steel wheels. . . . Sucks or blows 2,000 C.F.M. . . . Operates in any position. . . . Weighs but 70 pounds.

Adapters for three-4" nozzles or four-3" nozzles for flexible hose. . . . With caps to close nozzles not in use. . . . Each 4" metal hose of 20 foot lengths will exhaust 250 C.F.M. . . . and each 3" hose over 200 C.F.M. . . . Entire unit can be hung into a small manhole.

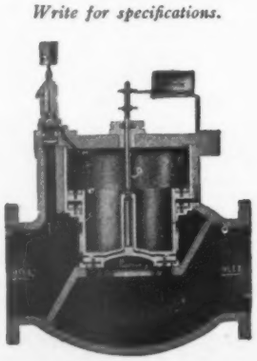
For further details, write Chelsea Fan and Blower Co., Inc., 1206 Grove St., Irvington, N. J.

Electric Double Cushioned Check Valve

This valve is for use in connection with remote tank storage service with valve located adjacent to motor centrifugal-pump, also where a high-low pressure or float-operated switch located at tank is wired to the valve in order to accomplish complete automatic sequence of operation for starting and stopping the pump with respect to storage water levels.

Sizes 3" to 36", angle and globe patterns.

Write for specifications.



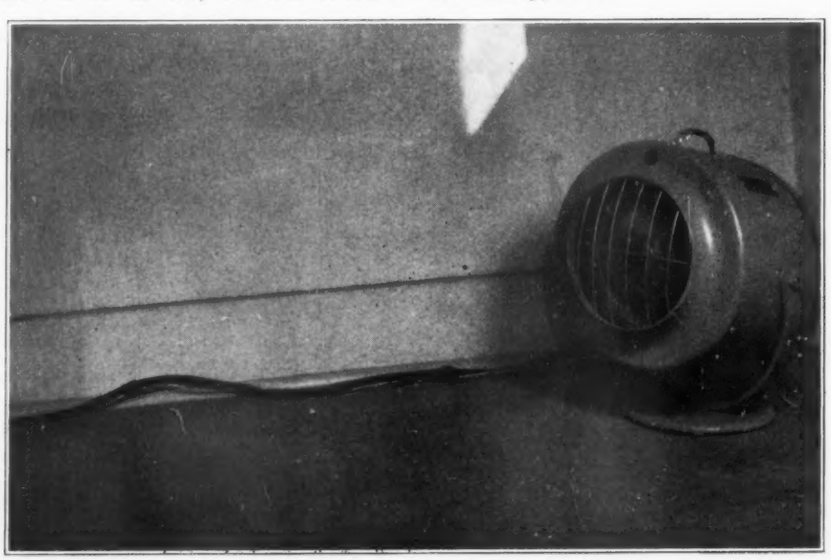
GOLDEN-ANDERSON VALVE SPECIALTY CO.
Fulton Building Pittsburgh, Pa.

G. E. Portable Forced-Convection Heaters

● This winter a great deal of attention is being given portable heaters for warming small space such as offices, guard towers, watchmen's houses, small pumping stations, chlorinator houses and many out-of-the way places. General Electric's new portable heaters of the forced convection type is one of these units.

Controlled automatically, and rated from 2 to 15 kw, General Electric forced-convection heaters are available in the suspension type for wall and ceiling mounting, as well as the portable type here pictured. The portable type, which while intended primarily for floor mounting, is readily adaptable for either wall or ceiling use. These "husky" heaters are sturdy, economical in operation, and easily and quickly installed, since it is only necessary to connect them to the nearest outlet.

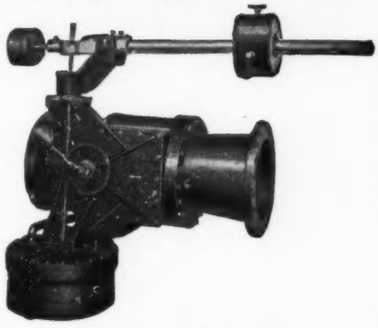
For descriptive literature and further details write General Electric Co., Schnectady, N. Y.



BUILDERS
WATER AND SEWAGE PLANT
Instruments

Type E Direct-Acting Controllers

Features include: precise control; compact, yet flexible design; powerful "floating piston" actuation with unique rubber piston seal; low loss of head; elbow outlet or straight through design; single blade vane-type valve; generous use of corrosion-resisting materials; and the use of the basic Venturi Tube.



Write for Bulletin 321

BUILDERS-PROVIDENCE, INC.
Division of Builders Iron Foundry
9 Codding Street Providence, R. I.

Where Is The Largest Rotary Distributor Installation in the U. S.?

Dayton, Ohio, with twenty 165′-diameter P.F.T. units — one of dozens of installations pictured and described in Bulletin No. 213.

The engineering data it contains shows why P.F.T. Rotary Distributors are by far the most widely used. Send for a copy.

P.F.T.

PACIFIC FLUSH-TANK COMPANY
4241 Ravenswood Ave., Chicago, Ill.
New York Charlotte, N. C.

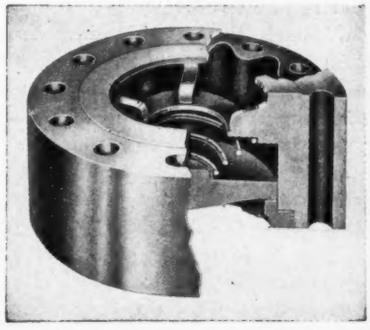
Truscon's New Water Emulsion Paint

• "Opaltone" is an oil-resin emulsion water paint, recently developed by the Truscon Laboratories. Once the coating has dried it is highly resistant to not only washing, but actual scrubbing.

"Opaltone" is applied to walls and ceiling with roller, brush, or by spray, and hides most surfaces in one coat. Neither linseed oil nor turpentine is required. Just add one gallon of water to two gallons of "Opaltone" and the paint is ready to apply. The new product requires no primer or scaler. It may be applied over a painted surface as readily as over such porous surfaces as wall board, concrete or plaster. It has no objectionable odor, and uses no critical raw materials. The paint comes in eight pastal shades and in pure white.

For additional information on this interesting new water emulsion paint, write to the Truscon Laboratories, Caniff & G.T.R.R., Detroit, Mich.

Williams-Hager Silent Check Valves



• The Williams Gauge Co., of Pittsburgh, Pa., announces an improved line of check valves which are furnished in a wide variety of metals and sizes. Designated as the Williams-Hager Flanged Silent Check Valves, they are manufactured of bronze, cast iron, steel, stainless and monel metal for pressures varying from 150 to 2500 lbs. to meet American Standard. Sizes range from 1 inch to 20 inches inclusive.

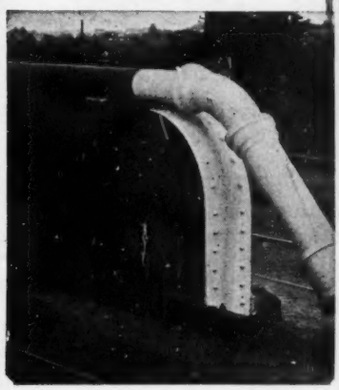
Simple, compact and rugged in design, the Williams-Hager Check Valve has but two parts subject to wear—the valve disc and seat. Both are easily removable and renewable, and the valve can be reseated without special tools. Note, particularly, the spring ring is now built as an integral part of the body.

These new valves are recommended for use in waterworks, boiler feed lines, and other non-return flowlines; in general in all pump lines handling water, oil, gas, acids, alkalies and other fluids.

The manufacturer will furnish descriptive literature and complete information on request. Address The Williams Gauge Co., 2068 Pennsylvania Ave., Pittsburgh, Pa.

LEADITE
The Pioneer Self-Caulking Material for C. I. Pipe

—withstands severe VIBRATION



—on c. i. bell and spigot pipe lines running over, or suspended from bridges, under railroad or trolley tracks, etc. In fact, Leadite has been called upon to meet most every condition common to water main construction.

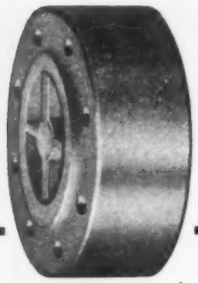
THE LEADITE COMPANY
Girard Trust Co. Bldg., Philadelphia, Pa.

No Caulking

INSTALLATIONS WORLD WIDE
LARGEST CITY TO SMALLEST VILLAGE

VALVES COMPLETE EQUIPMENT FOR WATER WORKS FILTRATION AND SEWAGE DISPOSAL PLANTS
LATEST "COREY TYPE" HYDRANTS

Write for Catalogue and Information
IOWA VALVE CO.
General Offices:
Hubbell Bldg., Des Moines, Iowa
Plant:
Oskaloosa, Iowa



. . . SMOLENSKY

Noiseless Flanged Check Valves

are used on pump discharge lines as a safety factor to protect the pumps against static load on high head to eliminate trouble, such as "water-hammer", "breakage of pumps," "pipe connections," etc.

They are also used as Foot Valves. They are quick-tight closing and are absolutely noiseless in operation.

Accepted by The Fire Underwriters.

Literature, gladly sent on request, shows dimensions and prices. Write to

THE SMOLENSKY VALVE CO.

1931 W. 47th St., Cleveland, Ohio

PITTSBURGH • DES MOINES

INCINERATION PLANTS

Any size, for the needs of any municipality—providing thorough, dependable and economical *High Temperature* incineration without smoke or odor nuisance. Our experience in solving disposal problems for cities and towns throughout America is yours, without obligation. Write for Bulletin No. 601.

PITTSBURGH • DES MOINES STEEL COMPANY

Pittsburgh, Pa. . . . 3412 Neville Island
Des Moines, Ia. . . . . 913 Tuttle Street

WITH THE MANUFACTURERS

Kienle Retires from Mathieson Alkali

Routh Made Vice President in Charge of Sales; Quinn Becomes Assistant Director of Sales.

● The Mathieson Alkali Works, Inc., announces the retirement of John A. Kienle, Vice President and Director of Sales, effective November 18th, 1942. Mr. Kienle joined the Mathieson Alkali Works as Manager of Sales in 1920, and was elected Vice President-Director of Sales in 1922. He came to Mathieson from the water works field and for several years was active in the affairs of the American Water Works Association.

Esse E. Routh has been elected Vice President-Director of Sales. He was educated at Virginia Polytechnic Institute and Davidson College. Mr. Routh enjoys the unique distinction of having spent his entire business career with the Mathieson Alkali Works, Inc., spending the early years of his service at the Saltville, Virginia Works, becoming Southern Sales Manager in 1920. In 1928 he was brought to New York as General Manager of Sales.

Robert J. Quinn becomes Assistant to the Vice President and Director of Sales. Mr. Quinn received his chemical engineering degree at the University of Illinois in 1912. He joined Mathieson in 1920 as Western District Sales Manager in Chicago, and was made Assistant General Manager of Sales and brought to New York in 1923.

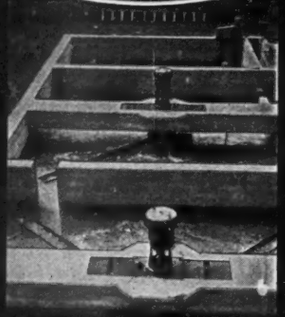
D. W. Drummond has been appointed General Manager of Sales. He was born in Philadelphia and graduated from the University of Pennsylvania in 1926. Mr. Drummond joined the Mathieson organization in 1938, becoming Assistant General Manager of Sales in 1941.

INQUIRIES INVITED on all Problems of WATER TREATMENT

Whether your problem of water rectification is large or small, we have a form of equipment to serve your needs. We manufacture and install equipment for Gravity Filtration and Softening Plants; Pressure Filters and Zeolite Softeners; Swimming Pool Recirculating Appliances; and Water Treatment Units of all types.

ROBERTS FILTER MFG. CO.
607 COLUMBIA AVE.
DARBY, PA.

AERO-MIX
AERATOR — MIXER

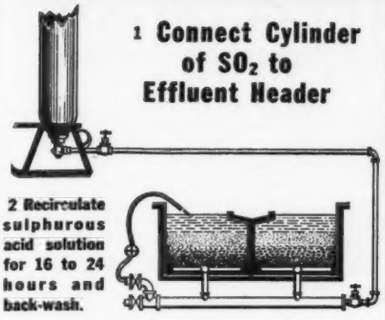


Down-Draft Type MECHANICAL SEWAGE AERATORS

Write for information on AER-O-MIX for your SEWAGE or WATER TREATMENT APPLICATION.

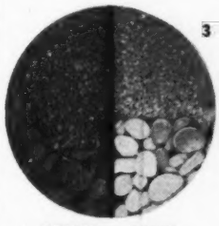
VOGT MFG. CO.
INCORPORATED
P. O. Box 1122 Louisville, Ky.

HOW TO CLEAN SAND FILTERS in 24 HOURS



1 Connect Cylinder of SO_2 to Effluent Header

2 Recirculate sulphurous acid solution for 16 to 24 hours and back-wash.



3 RESULT: Clear, white sand and gravel; time, labor and money saved

BEFORE AFTER

VIRGINIA SMELTING COMPANY
WEST NORFOLK, VIRGINIA

Wood Water Towers Design Assistance Offered

● Due to a decision by the War Production Board to decline priorities for steel to be used in the construction of water towers, the Timber Engineering Co., Washington, D. C., has been receiving a growing number of requests for aid in designing wood towers for water tanks.

The company has several water tower designs, listed below, on hand and is distributing them free upon request:

Height	Size
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Randall Becomes President of Neptune of Canada

● Wm. T. Randall, who has long been Neptune's Canadian manager, has recently been elected President of Neptune Meters, Ltd., the Canadian subsidiary of Neptune Meter Co. of America.

For a number of years Mr. Randall has been taking an active and leading part in the affairs of A.W.W.A.'s Canadian Section, the 1942 annual meeting being the first in years that "Bill" Randall has missed attending—and this was because of his war activities and the fact that Neptune has built a special plant in Canada for the production of highly essential precision instruments for war use.

Foxboro Founder Dies

● Mr. Bennet B. Bristol, who with his brother Edgar H. Bristol founded the Industrial Instrument Co., in 1908, which later became The Foxboro Co., died at his summer home at Falmouth Heights, Mass., on Tuesday, November 10th, following several months' rest from a heart attack, suffered last May. Mr. Bristol was born in Naugatuck, Conn., May 3, 1868. In 1893 he was graduated, M.E., from the Stevens Institute of Technology. Throughout the history of The Foxboro Co. he served as its Treasurer and Clerk.

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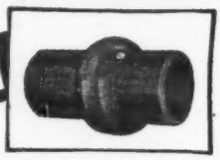

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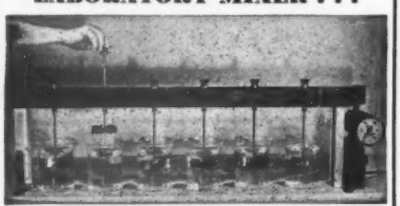

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Townsend Advanced in G-E Motor Division

● J. Townsend has been appointed Assistant Sales Manager, Fractional-horsepower Motor Section, of General Electric's Motor Division, it was announced recently by W. H. Henry, Manager of the Motor Division.

A native of Syracuse, N. Y., Mr. Townsend was graduated from Syracuse University with a degree in Electical Engineering in 1925, and later that year joined General Electric as a student engineers at the Ft. Wayne Works.

Early in 1926, he was transferred to the Fractional-hp Motor Sales Dept., Ft. Wayne Works, and later that year to the same department in the Company's Chicago Office. During the period from 1926 to 1937 he has been located in the Chicago, the Detroit and the Grand Rapids Offices. Since 1937, he has specialized in the sale and service of fractional-hp motors.

James M. Hait Named General Manager of New Food Machinery Div.

● James M. Hait, for many years Chief Engineer of the Peerless Pump Division-Food Machinery Corp., and credited with many of the firsts in pump design, has been working diligently in the development of Amphibian Tanks for our Government during the past year. Although, designing and building Amphibian Tanks is a far cry from designing and manufacturing turbine and other types of pumps, the results of his efforts have been outstanding.

As a consequence, it has become necessary for Food Machinery Corp. to establish a new division, to be known as the Division of Procurement and Engineering. Mr. Hait has been selected as General Manager of this new division. He has, already contributed a noteworthy service in the design and development of Amphibian Tanks,—by the U. S. Marines called "Alligators".

Wm. C. Carter Elected President

● Link-Belt Co. announce that Mr. Carter, for fourteen years vice-president and for the past year executive vice-president, has been elected president, effective December 31, to succeed Mr. Alfred Kauffmann, who has resigned because of ill health.

Mr. Carter, a mechanical engineering graduate of the University of Illinois, joined the Link-Belt organization in 1902 as a draftsman. He has consecutively held the positions of engineering department superviser, construction superintendent, plans superintendent, plant general manager, vice-president in charge of production.

Corydon Leaves Proportioneers

● Word has been received that Jeff Corydon resigned on December 11th, as President and Director of % Proportioneers, Inc. % of Providence, R. I.

Mr. Corydon's announcement states that his resignation involves severing all active connection with the company other than his interest as a stockholder.

After a short vacation, Mr. Corydon is planning on a new activity to be announced later.

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"We Are Re-gusted"

H. P. Binder

● On page 80 of our November issue is an item announcing the elevation of H. P. ("Horse Power") Binder to managership of the Centrifugal Pump Department of Allis-Chalmers and appointment of Dr. Wm. White as manager of A-C's Hydraulic Division.

Accompanying the announcement was a picture of Mr. Binder who for 30 years has served Allis-Chalmers. The announcement was credited to Mr. Walter Geist, A-C's president, whose name appeared in the lead off line. This we take it, explains the slip-up on the part of someone in the make-up department who captioned Mr. Binder's picture Walter Geist—then the typesetter helped a lot by making it Gust instead of Geist. Here is Mr. Binder again properly labelled and as we said we are "re-gusted."

Maritime "M" Won by Cooper-Bessemer

● For its outstanding production of engines and engine parts for Liberty ships, Cooper-Bessemer Corp.—for 109 years builders of engines—was given the Maritime "M"—the highest award of the U. S. Maritime Commission.

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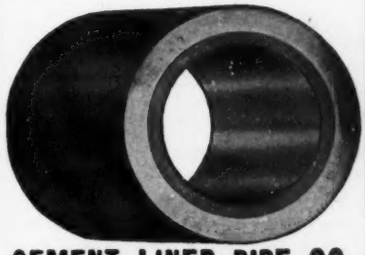

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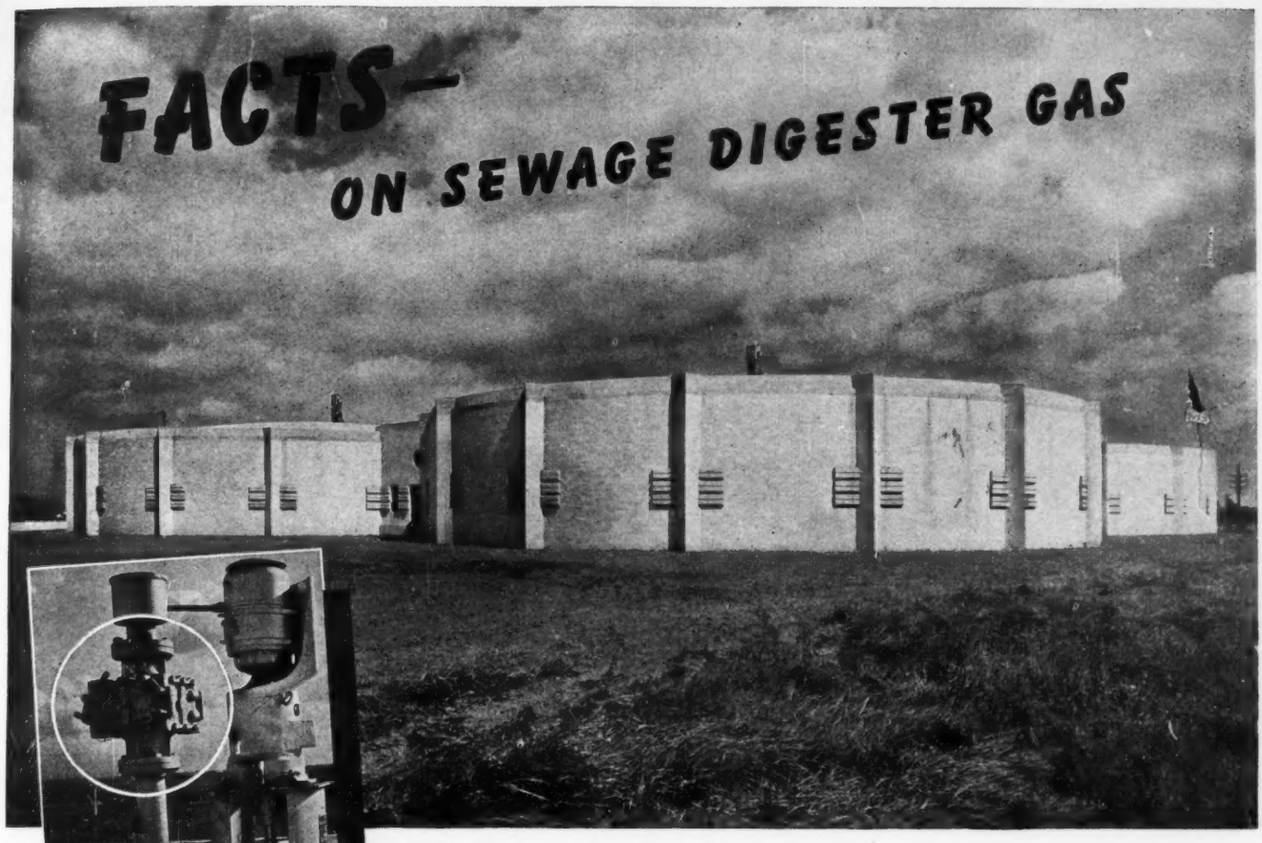
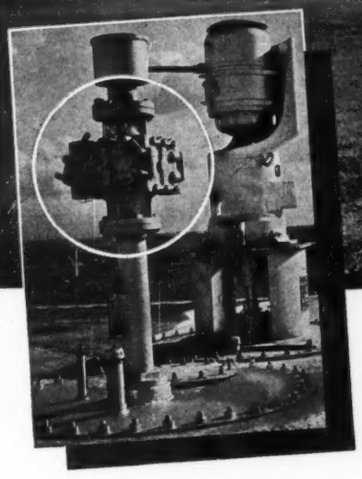
FACTS— ON SEWAGE DIGESTER GAS





◀ *Closeup of pressure relief valve and flame arrester.*

AND DORR DIGESTER SAFETY

IT has been erroneously stated that the gas storage capacity of fixed cover tanks presents an extreme explosive and fire hazard. This is *not* true in the case of Dorr Digesters—based first upon the fundamentals of gas combustion and second upon the elements of design incorporated in Dorr units.

It is a fact that not less than 2% or more than 15% sewage gas must be mixed with air to create an explosive mixture. As the generation of gas is continuous in any digester, the only time air can possibly be present is during a sludge draw-off. Even under the most dangerous conditions, where gas capacity is 5% of the tank volume, 28% of the tank capacity must be drawn off to reach the danger point. As the average draw-off is less than half of that, an explosive mixture cannot possibly be attained during normal operation.

It is true however that sewage gas is inflammable—regardless of digester tank design. Here, the fixed cover as used in Dorr Digesters is definitely an advantage, for it allows positive control of venting at *one* point—with no chance of leakage around tank walls. This single point is controlled by a special pressure relief valve and flame arrester supplied on all Dorr units, which is approved by the National Board of Fire Underwriters.

The best proof of Dorr Digester ability to deliver the goods is the trouble free performance records of hundreds of installations serving cities and towns all over the world.

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Your part in the A.W.W.A. campaign to "*Save, Stretch and Share to Win the War*" calls for a careful check-up on your chlorination practice. Particularly if you must now furnish more water than your treatment plant was designed to handle...chlorination can often be more fully utilized to stretch capacity safely.

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Chlorination can also help you in putting pipelines in condition to handle greater capacities. It can reduce filter loads and assure the safety of unfiltered supplies.

It's the war job of your Wallace & Tiernan Representative to make sure you get maximum protection from every pound of chlorine you use. He'll help you pick the right point and rates of application for *capacity-stretching* service. And he'll see to it that your W&T Chlorinators are in trim to meet the "squeeze". SA-141